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MARCH 1966

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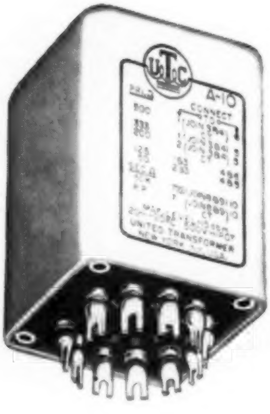

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73 Magazine

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Have you ever met a ham who hasn't had an S-38—once?

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Here's a tester that sings at you.

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A little more fuel for it.

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Stuffy readers: skip this.

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Who could improve on this title?

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Maybe a little more appreciation of the FCC is called for.

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They're getting mighty thin.

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de W2NSD/1

never say die

Now What?

Several of the national radio societies in Europe, discouraged at the head-in-the-sand attitude of the League, had turned their hopes toward the International Amateur Radio Club, the IARC, which had been formed by officials of the I.T.U. (International Telecommunications Union). Now, with the IARC virtually scuttled by the Afro-Asian take-over of the ITU, no one knows where to turn.

There is the possibility that the International Amateur Radio Union Region I will free itself of the Old Man of the Sea in Newington who has so far kept it weak and impotent. The IARU is a loose union of European radio societies which has been working together on mutual problems. Unfortunately for the IARU its headquarters are in Newington and the League has been rather successful in preventing the growth of this threat to their omnipotence.

Many of us are looking very hopefully to the Institute of Amateur Radio not only for the safety of amateur radio in the U.S., but world wide. Amateur radio has gone for some fifty years now with absolutely no representation in our country and it has lost at every conference. The future of the Institute is up to you . . . and the future of amateur radio looks to me as if it is riding on your support of the Institute.

What can the Institute do that will help? First of all it can keep amateur radio alive in the minds of our representatives in Washington. If we have the Senate and House behind us we not only will protect ourselves in our own country, but we will be sure to have our representatives behind amateur radio at the conference tables in Geneva. I was present at Geneva at the last conference and I tell you now frankly and openly that the U.S. government did not have any intention of supporting amateur radio at that conference. Only a miracle saved us from catastrophe.

The miracle that saved us was the putting off of frequency reorganizations until the next conference. No miracle can save us next time because the whole purpose of the conference will be the redistribution of frequencies. As it stands right now amateur radio will go into this conference with a small handful of friends and a host of enemies . . . and these enemies include the biggest of them all: our own government.

If every active amateur sent the Institute $5 a year for the next three years I think we would have a good chance of getting our point across and ending up with usable ham bands. I'd give it a 75% chance. The way things are going right now it looks like we have a 5% chance of coming out reasonably well.

After talking this problem over with the heads of several national radio societies and many seriously interested and knowledgeable amateurs the best course of action, after making sure that our government is firmly behind us, is to actively tackle the problem at is weakest point: the African and Asian countries.

First of all it has been proposed that the Institute send illustrated information sheets on the values of amateur radio to small countries directly to the heads of these countries as well as their communications chiefs. This literature would emphasize the value to small countries of encouraging amateur radio and the help that the Institute is prepared to furnish those interested. It would point out that it is only when an amateur radio population has been established in a country that any sort of electronics industry is at all possible . . . and no country anywhere can grow even a little without electronics and communications. Amateur radio is one of the most important keys to the starting of a large growth of a country. The Arabs may hate Israel, but they won't overlook the fact that the hams there were of critical importance in the setting up of the country and the rapid industrialization of it.

Amateur radio not only encourages electronic industry to be formed in a country, but also provides men with the know-how to set up communications. Modern civilization rests firmly on the telephone.

How about tourists? Ham radio can help considerably for each amateur in a country is a valuable good will ambassador. Thousands of us travel all around the world visiting amateurs that have asked us on the air to drop in. Countries without amateur stations may get a one-man DXpedition once every ten years, but those with active amateurs draw

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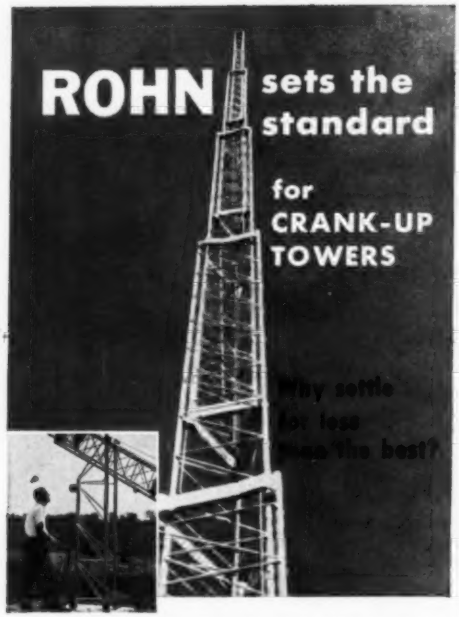

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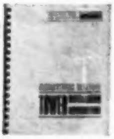

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a lot more visitors. Ask any DX amateur how many fellows have visited him during the last years or so . . . you'll find the number surprising . . . and so will the tourist. Of course this spreads too for once back home we show our slides and movies to our local Rotary Club and before long many more people are thinking of visiting what was before an unknown country.

The Institute would like not only to approach foreign governments by mail, but to send "Ham Corps" groups to these countries to personally talk with these men and offer to set up a ham station and train some of the locals to operate it. Several manufacturers have indicated that they would be glad to support such a program and we have already had letters from many amateurs who are willing to work on such a project at no pay. I believe that we could organize a number of two and three man groups to visit the smaller countries who will have an effect on the course of the ITU all out of proportion to their size and sell these governments on amateur radio for their country.

DXing

For some time now I've been hinting that I'd like to encourage DXing a bit in 73. The question has been just what we could do that would be the best. I certainly didn't want to turn out another DX column like the ones in CQ and QST, that's for sure.

There has been considerable grumbling over certain deficiencies in the QST listings and, after considerable discussion with Gus, Stu W2GHK, and other DX luminaries, perhaps we have an answer. The recent decision by QST to do away with phone DX listings in the Honor Roll and other changes certainly emphasizes the already apparent problems of the DXCC.

Our solution is to plunge seriously into the DX Certificate game.

The One Hundred Country Award Certificate will be available from 73 starting this summer. We will also have available Two Hundred Country, Three Hundred Country and Worked The World Three Hundred and Fifty Country Award Certificates.

Gus, W4BPD, who will be in charge of the project, will give you the full details on the rules. Roughly, here are the basic features:
Countries Countries accepted by QST, RSGB, REF, DARC and certain other national amateur radio societies will be accepted as "countries."

(continued on page 86)

AND NOW . . . from *Waters* the

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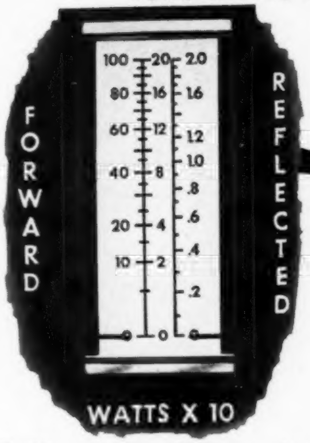

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Impedance	52 ohms.
Frequency Range	3 to 30 megacycles.
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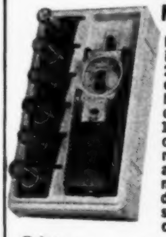

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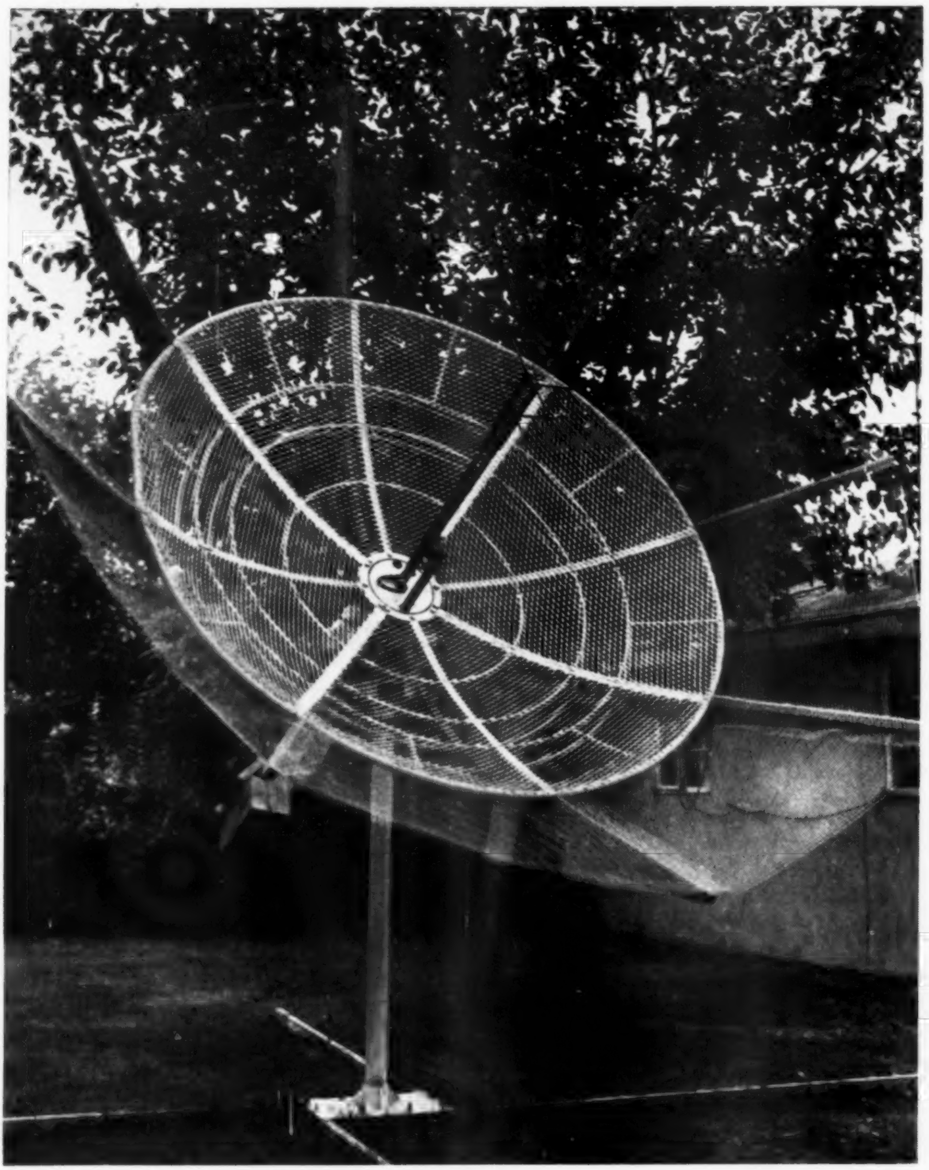


Thirteen foot dish with reversible sense feed system installed.

Photos by Joe DeYoung.

Circular Polarization

Jim Kennedy K6MIO
2816 E. Norwich
Fresno, California

For a number of years, the use of circular polarization has been fairly common in some areas of professional communications. The utility and often the necessity of this type of wave propagation in communicating with satelites and space probes has long been established. Further, at least some types of tropospheric paths seem to demonstrate greater reliability when circular polarization is employed.

Until fairly recently, however, circular polarization had offered very little advantage over the common linear polarizations in general use, as far as the amateur operator was concerned.

The state of the art is advancing, though, and increased interest in moonbounce, UHF trops and OSCAR, may well lead to a much wider use of this mode among the amateur fraternity as, in each of these areas, circular polarization can, at times, provide superior communications.

Most VHF operators are familiar with horizontal and vertical linear polarization and the substantial signal loss associated with "cross" polarization. This is the result of certain characteristics of the electro-magnetic wave, which will be reviewed in a moment. In moonbounce, particularly on the frequencies below 1296 mc, a phenomenon called "Faraday rotation" can cause the plane of polarization to be shifted or rotated as the signal passes through the ionosphere on its way to and from the moon. This can be a real nuisance as a "horizontal" signal may produce a more or less "vertical" echo and, hence, the echo may be greatly reduced in strength or, perhaps, not heard at all.

The signal transmitted by a spinning or tumbling satelite may vary from horizontal to vertical in a rapid and often complex fashion causing flutter and fading in linear receiving systems.

Polarization can also be shifted by atmospheric and terrain conditions over a long tropospheric path. This can be anything from a permanent to a rapidly changing condition and, hence, its effect can vary from a constant signal of reduced strength to a signal with rapid QSB.

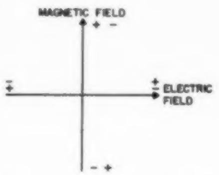


Fig. 1. End view of electromagnetic wave.

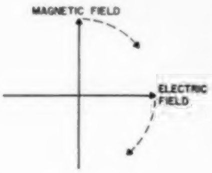


Fig. 2. Rotation of fields in a circular wave.

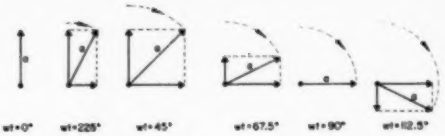


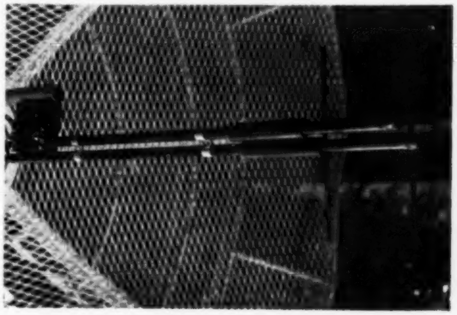
Fig. 3. Synthesis of circular polarization from vertical and horizontal polarization. Those w's are really ω's.

To begin a discussion of circular polarization and how it can be of use in some of these situations, it seems appropriate to start by reviewing some of the facts concerning the electromagnetic wave—the radio signal on its way through space.

A radio wave is composed of two different types of fields traveling together. These composite fields, one, an electric field, the other, a magnetic field, travel in the same direction, but are oriented at right angles to each other. **Fig. 1** shows a diagram of how this might look if we could see the "lines" of force. The direction of wave travel in this diagram is straight up out of the page.

In linear polarization, the direction of the two fields remains constant and the amplitude changes from plus to minus and back again at a sine wave rate at the RF frequency. The polarization is said to be horizontal, if the electric field is horizontal; and vertical, if the electric field is vertical. Of course, it can also be diagonal but this is not commonly used.

If such a signal is to be received, it is necessary that the antenna "tap" one of these fields to remove the energy and convert it into an RF voltage for the receiver to detect. It is only necessary to tap one field, as energy from the other changes to the field being tapped as the tapped field's energy is depleted



Close up of twin boom type of reversible feed.

2 MTR. TRANSCEIVER
LITTLE MARVEL
LOG

Well now. Ready to go. Guess I'll start with Australia.

by the antenna and hence almost all the energy is available to the receiver.

Some antennas tap the electric field and others the magnatic field For instance, the simple dipole taps the electric field while the loop antenna taps the magnetic field. For the purposes of this discussion, however, we will consider only antennas that tap the electric field, though the principles involved apply to both types.

Cross polarization occurs when an antenna cannot "see" the field it is designed to tap. A dipole must be in the same plane as the electric field in the incoming wave. As the angle between the electric filed and the dipole increases from 0° toward 90°, the amount of field the dipole "sees" becomes progressively less and less until, at 90°, their is no component of the electirc field which lies in the same plane as the antenna and hence no voltage is induced at all, or stated mathematically, the voltage induced on the antenna:

$$e - E \cos \Theta$$

where Θ is the angle between the two antennas, and E is the magnitude of the wave electric field.

We now have a rough picture of what is happening in a linearly polarized radio wave and how it effects a receiving antenna.

The twist

As mentioned before, the direction of the fields, in a linear wave, remain fixed and only the amplitude changes. A circular polarized wave, however, is just the opposite. In it, the amplitude of the two fields remains constant and the direction of the fields always remain perpendicular to each other, but togethr, they rotate, making one complete revolution each RF cycle, as shown in **Fig. 2.**

Just how this comes about is a bit more complicated than linear polarization. This is due to the fact that a circular polarized wave is actually a composite of *two* linear waves. It is the result of horizontal and vertical linear waves 90° out of phase. **Fig. 3** shows this as a series of "snapshots" of the two electric fields through a little more than the first quarter of a cycle. Don't confuse this with the earlier diagrams. Both the fields shown are electric fields; the magnetic fields are present, but have been omitted from the diagram for the sake of convenience. It will be noted that both of these fields are changing in amplitude, as they are linearly polarized, but, also notice that, because of the 90° phase defference, the composite amplitude—the vector sum—of the two fields is constant and rotates from horizontal to vertical in a circular fashion once per RF cycle.

For those who prefer a mathematical explanation: the vertical component $y = a \sin \omega t$; the horizontal component $x = a \sin (\omega t + 90°) = a \cos \omega t$; where a = constant and ωt = RF phase angle.

The amplitude of the resultant field:

$$\begin{aligned} |A| &= \sqrt{a^2 \sin^2 \omega t + a^2 \cos^2 \omega t} \\ &= \sqrt{a^2 (\sin^2 \omega t + \cos^2 \omega t)} \\ &= a \end{aligned}$$

and since $|A|$ is constant as ωt goes from 0 to 2π the field vector rotates in a circular fashion about the origin.

It has probably occurred to many that there are two possible senses or directions for the fields to rotate, either to the right or to the left—clockwise or counterclockwise. This is, in fact, the case and hence, there are two kinds of circular polarization: right hand sense and left hand sense. If the sense is right hand, the field rotates clockwise as viewed from behind the wave; that is, it rotates the same way a right hand screw does when it advances.

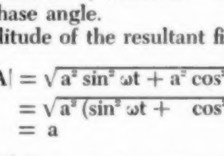
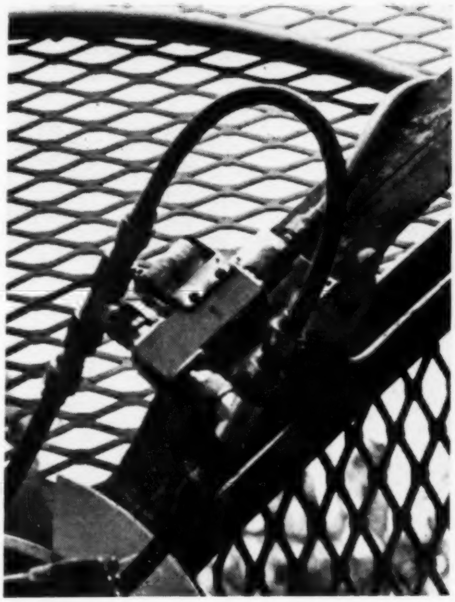


Fig. 4. Fixed circular polarization from two dipoles.



Sense reversing relay and delay line mechanism. Dipole feed lines are on the left and the input line on the right.

Though it is impossible to be cross–polarized with circular polarization, it is possible to be "cross-sensed." If this occurs, one of the two linear components of the wave is out of phase and hence, cancellation takes place. In other words, right hand systems don't receive left hand signals and vice versa. This can present some of the same problems as cross polarization, though as we shall see in a moment this can be easily circumvented, if necessary.

There are at least two practical ways to generate a circular wave, one common way is to synthesize it continuously with a helix. The helix can provide high antenna gain and be quite effective, though, the single bay helix is less versatile than another method about to be described.

The second method is to synthesize the wave by gathering and combining its component parts, that is, two linear polarized signals oriented at right angles and 90° out of phase.

The simplest way to do this is to co-locate two dipoles at right angles on a common boom in the form of plus sign. If these dipoles are fed with feed lines which differ in length by some odd multiple of a quarter wave length (90°), as in **Fig. 4**, then the dipoles will emit a circular polarized signal. If gain is wished then plus sign reflectors and plus sign directors can be added to the boom to form a yagi or broadside array.

As mentioned, this type of array can be very versatile; for instance, if both left and right hand polarization is desired, it is only necessary to provide for the reversing of the phasing, as shown in **Fig. 5.** In fact, with suitable switching, it is possible to have horizontal or vertical linear, or, right hand or left hand circular polarization from the same antenna at will.

As the circular wave is made up of two linear components, it is possible to work between a circular antenna and any linear antenna in any plane without cross polarization taking place. There will generally be a 3 db loss between the two types of systems as only half the power in the circular signal is contained in the particular linear component that the linear antenna is receiving.

If the path is causing polarization shifts, as in the trops circuits previously discussed, circular polarization, on even one end of the circuit, would improve the range of QSB and often will increase the average signal level. Circular antennas on both ends would do the same without inflicting the 3 db loss.

In moonbounce circuits, circular polarization eliminates the effect of Faraday rotation. The further rotation of a wave, that is already rotating inherently and received on an antenna designed to receive rotating waves, has no effect at all. In other words, you can turn a circle around to your heart's content and it still looks like a circle.

There is a problem, however, in moonbounce circuits and others involving signal reflections. A circular signal reflected by a passive reflector, such as the moon will return as a reverse image much the same as light images reflected by a mirror. The sense will reverse; the right hand becomes left hand and vice versa. The solution to this problem is

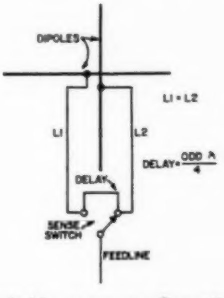


Fig. 5. Switchable sense configuration for both right and left sense.

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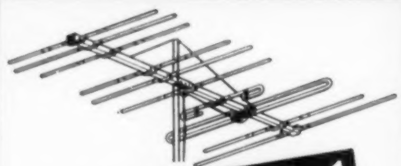

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4-3 Element Colinear Directors	2-Directors

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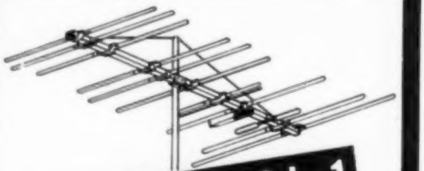
Stacking Kit $2.19



2 ANTENNAS in 1

MODEL A-62 GMC · 50 OHM

On 2 Meters:	On 6 Meters:
Equivalent to 18 Elements	4 Elements
1-Gamma-Matched Dipole	1-Gamma-Matched Dipole
1-3 Element Colinear Reflector	1-Reflector
4-3 Element Colinear Directors	2-Directors

Amateur Net $34.50
Stacking Kit $18.00

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On 2 Meters:	On 6 Meters:
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simple, however. It is only necessary to wire the sense reversing relay, on a switchable plus sign array, into the antenna change over circuits and transmit in one sense and receive in the other.

KP4BPZ utilized circular polarization in the Arecibo moonbounce experiments in 1964 and 1965. The system in use there transmitted right hand in space and received left hand in space.

The switching technique, using the scheme shown in **Fig. 5**, was used at K6MIO in the second 1965 KP4BPZ 432 mc moonbounce test. It showed substantial increase in received signal over the first 1965 test in which linear polarization was used by K6MIO.

The feed array for the 13 foot (4 meters) dish used in the tests is shown in the photographs. As the booms for the antennas are pieces of rigid coax—the feedline—it was not practical to use the same boom for both dipole—reflector arrays. The separate arrays where placed as close together as possible and fed with equal feedline lengths to the sense relay. The delay line at the sense relay was ¼λ and the relay was wired into the antenna change over circuit.

The dish feed itself transmits left hand which, when reflected by the dish, becomes right hand (in space) and vice versa on receive. In this way the system matched the polarization used by KP4BPZ.

Reversing the sense sequence did, as predicted, result in a very substantial signal loss as "cross sensing" took place.

Summary

To recap this discussion; circular polarization occurs when the instantaneous electric and magnetic field amplitudes in an electromagnetic wave remain constant and the direction of the field vectors rotate from 0° to 360° constantly, making one full revolution per rf cycle.

There are two possible directions or senses for rotation to take place, either right hand or left hand. Right and left hand systems are incompatible on the air, but antenna can be easily designed to make use of either one at will.

The fields can be made to rotate the prescribed manner by at least two methods (actually there are several more). One method is to force the fields to rotate by combining two sets of fields at right angles to each other and in phase quadrature (90° phase difference).

Finally, and perhaps most important, it really works.

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Solid State Sixty

The radio amateur today cannot help but notice the wide variety of semiconductor devices being advertised in *73* and other electronic orientated magazines. These devices, selling at a fraction of their original cost, were unheard of a few years back. For the ham who likes to build and experiment with these fascinating items, I will describe an adjustable, regulated, solid state power supply which is both easy to build and use.

Basically the unit consists of two supplies. T_1, T_2 and their associated circuitry make up the main, heavy current carrying supply. T_3 and its associated circuitry serves only to provide amplifier chain Q_1, Q_2 and Q_3 with a well-regulated reference voltage. Both supplies are common series type regulators, with Q_1 and Q_4 being the regulating element for each. Amplifiers Q_2 and Q_3 are included to isolate Q_1's base from the 5K pot, so that only a small current is needed at Q_3's base to swing the large base current at Q_1. A close look at the diagram will show that all the transistors are being operated as emitter followers, or current amplifiers. The output from diode bridge D_5-D_8, after being filtered by C_2, is applied to the collector of Q_4 and the 620 ohm resistor. The 620 ohm resistor is picked to fire zener D_9 with about 10 ma of current. The zenor voltage is applied to the base of Q_4 and appears at the emitter, minus the .6 volt or so drop associated with silicon-type devices. The 5K linear pot serves as the emitter load and by tapping up and down this resistor, a voltage of from 0-33 volts approximately is available to control amplifiers Q_3 and Q_2. Autotransformer T_1 is coupled mechanically to the shaft of the 5K pot. This is done so that no matter what the voltage of the unit is set at, the drop across Q_1's collector to emitter is constantly 5 or so volts. If this were not done, using the unit at say 9 volts would require the series element Q_1 to dissipate the voltage difference between 9 volts and the total voltage that would appear across C_1. The voltage across C_1 is about 40 volts without the autotransformer so we have 40 minus 9, or 31 volts times the rated current of 2 amp, or a dissipation of 62 watts. Since the output rating of the supply is 60 watts (30 x 2) we see that more wattage is being used to heat the shack than is available for our bench projects. Putting T_1 in ahead of T_2 modifies the voltage available at C_1 so that approximately 5 more volts is available at C_1 than is supplied to its base by the reference supply. So the dissipation of Q_1 is 5 x 2 or 10 watts, and this is just lukewarm. Since most transistor projects require considerably less current, unless you are power minded, the unit will run at room temperature.

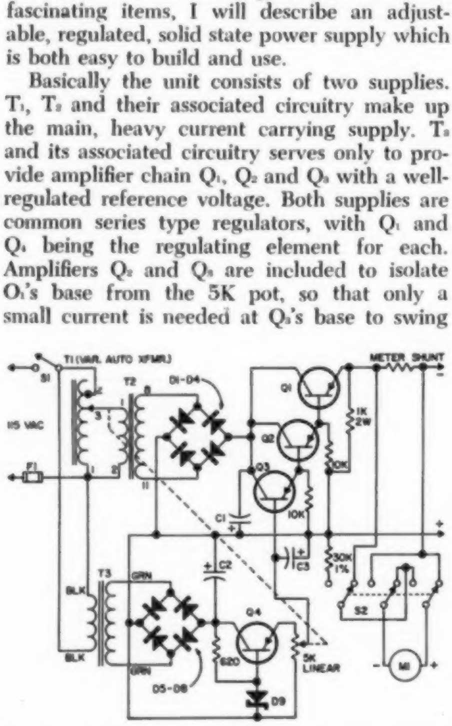


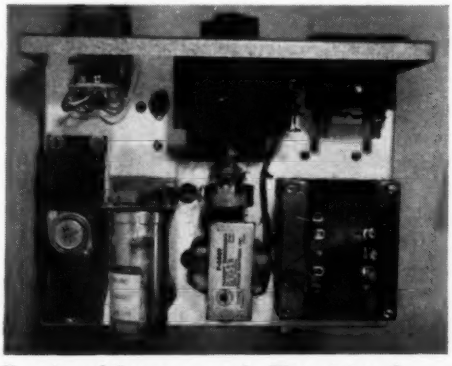
Fig. 1. Schematic of the solid state 60 watt power supply.

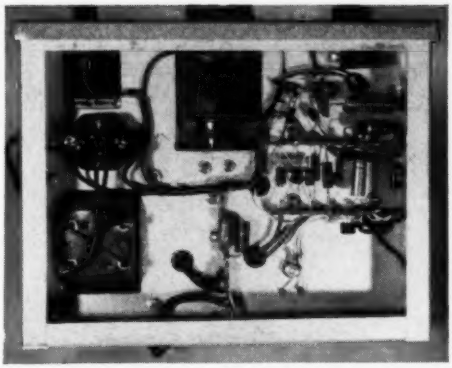
Construction and parts placement are not critical. Two items to watch for are that the 5K control pot has a linear taper and to use #16 or better wire for the high current carrying half of the supply. I used a California Chassis type LTC-464 cabinet and had to squeeze a little, but a larger cabinet will do nicely. Q_1 is mounted on a Delta Heat sink NC-401 and the sink insulated from the chassis, or insulate the transistor from the sink if you want. Q_2 is mounted under C_1 and insulated from the chassis with a mica insulator.

The photo of the top of the chassis shows the method of coupling the 5K pot to the autotransformer. I used a quarter-inch shaft coupling fastened with epoxy cement to the wiper of the autotransformer and supported the pot with a bracket made of sheet aluminum. Series regulator Q_4 and its socket can also be seen in the top view mounted between the autotransformer and the meter range selector switch. The coil of wire shown in the bottom view near the front of the chassis is the meter shunt. A good starting place for a 1-ma meter is about 1-¾ feet of #16 enameled copper wire.

A new meter face was inked on white paper and glued to the existing face. The new ranges are 0-30 volts and 0-3 amperes. I intentionally extended the current scale to 3 amperes, for as we all know, hams are notorious for drawing more than the rated current from transformers for short periods of time.

To adjust the pot and transformer, set them initially at their maximum voltage positions. Do this without the AC plug in. Lock the pot shaft to the autotransformer. Bring the pot and transformer back to zero and plug the supply into the AC outlet. Put a voltmeter across the collector to emitter of Q_1 and turn the switch on. Set the supply for about 10 volts output and note the reading across Q_1. If it is anywhere from 4-6 volts, you are in business; if not, turn the switch off and not disturbing the pot or transformer unlock the shaft. If the voltage drop was higher than 6 volts, hold the pot shaft from turning and move the wiper of the transformer about ¼" back toward its zero position and lock the shaft. If it was lower, move the wiper up about ¼" toward its maximum voltage position and lock the shaft. Turn the unit on and again measure across Q_1. Continue to do this until the correct voltage drop is achieved.


Top view of the power supply. The autotransformer is in the center at the top, coupled to the variable resistor below it.


Bottom view of the supply. The black object in the left center is a full wave rectifier.

As for procuring the parts, if you buy new it is going to cost you. Meshna, who advertises in 73, sells a transistor suitable for Q_1 already mounted on the proper heat sink for a buck and a half. Poly Paks, who also advertises in 73, has the 2N1132's at a reasonable price, and a look through their ad should find the necessary bridge rectifiers and zener diode. As far the transformers and other parts, you are on your own.

. . . K3LCU

Parts List

T_1 — Superior Powerstat type 10B
T_2 — Stancor type RT-202 or Allied No. 62-G-332
T_3 — Stancor type P-6469 or Allied No. 61-G-421
D_5, D_6, D_7, D_8 — 100 PIV 100 ma diodes or better as: Texas Inst. 1N537 or Motorola 1N4002
D_1, D_2, D_3, D_4 — 3-5 amp 100 PIV diodes or better: GE 1N3569
Q_1, Q_2 — Motorola 2N376A
Q_3, Q_4 — Motorola 2N1132
D_9 — 33 volt 1 watt zener diode Sarkes Tarzian VR-33
C_1 — 1500 μf 50 volt capacitor Sprague TVL-1341
C_2, C_3 — 100 μf 50 volt capacitor Sprague TVA-1310
M_1 — 1 ma meter
S_1 — SPST switch
S_2 — 3 pole 2 position rotary switch
F_1 — 1 amp fuse

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3780 Starr King Circle
Palo Alto, California

Crystal Oscillators: Tube, Transistor and FET

Most standard crystals, surplus or otherwise available inexpensively, are for vacuum tube circuits. If used in transistor oscillators, these crystals usually oscillate on slightly different frequencies than marked, since most transistor circuits operate at low impedance levels unlike tube circuits.

Transistor crystal oscillator circuits fall into two categories: those which operate near the series resonance of the crystal (f_s) and those which operate near the parallel resonance of the crystal (f_∞). These operation points are illustrated in **Fig. 1.**

Several oscillators of the series resonance type are shown in **Fig. 2.** Note that in each circuit, if one were to remove the crystal, and substitute a blocking capacitor, the circuit would continue to oscillate at about the same frequency. That is, the crystal in the oscillating circuit looks like a small resistance.

The circuits that utilize the parallel resonance of the crystal all operate slightly on the inductive side of f_∞. Thus, these circuits are all, after they have been broken down to basics, Colpitts oscillators. Two examples of this type of oscillator are shown in **Fig. 3**; the only difference between them is that one is grounded-base and the other grounded-emitter.

If one picks the C_{be} and C_{ce} capacitances such that they yield 32 pf in series (or supple-

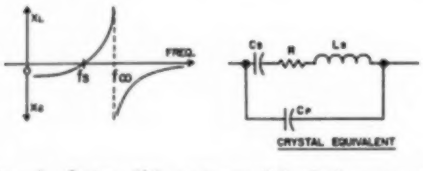


Fig. 1. Series (f_s) and parallel (f_∞) resonant points for crystals.

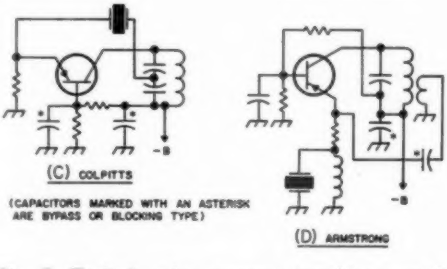
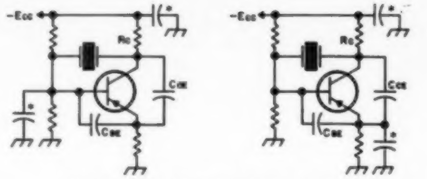

-B
(A) HARTLEY
-B
(B) TICKLER FEEDBACK
-B
(C) COLPITTS
(CAPACITORS MARKED WITH AN ASTERISK ARE BYPASS OR BLOCKING TYPE)
-B
(D) ARMSTRONG

Fig. 2. Typical series resonant transistor crystal oscillators.


-Ecc
Rc
Cce
Cbe
*

(CAPACITORS WITH ASTERISK ARE BYPASS OR BLOCKING TYPE)

(A) COLPITTS, CAPACITIVE DIVIDER FORMED BY Cbe AND Cce

(B) SAME AS (A) EXCEPT COMMON-EMITTER RATHER THAN COMMON-BASE

Fig. 3. Parallel resonant crystal oscillators.

ments them external to the transistor to give 32 pf) then the crystal will oscillate on its marked frequency in most cases. Of course, the voltage division ratio of C_{be} and C_{ce} must also be adjusted to give a feedback factor commensurate with the β of the transistor.

There are a host of other transistor crystal oscillators, which work to one degree or another. These, for the most part, are subject to adjustment and the individual transistor's characteristics, costing the designer the very stability he used crystals to obtain. Possibly the most satisfactory circuit for use with "32 pf" crystals is the very tube circuit for which it was designed—but replacing the tube with a field effect transistor. In this way, the impedance levels are of the same order and the circuit is readily dealt with by technicians experienced in tube circuitry.

For a short period of time, when FET's (Field Effect Transistors) were first introduced, their prices were quite high. However, although there are still some in the $50/each category, a number of reasonably priced FET's are available for experimenter use. Siliconix now has their U146 and U147 at about $3.00; these P-channel Silicon units are of the 2N2606 family.[1]

FET's can be thought of as near equivalents of vacuum tubes. The drain corresponding the plate, the gate to the grid, and the source to the cathode. This correspondence is a much better one than the collector-plate, base-grid, and emitter-cathode set for bipolar transistors and tubes. As in a tube, the current through the FET is controlled by the *voltage* between

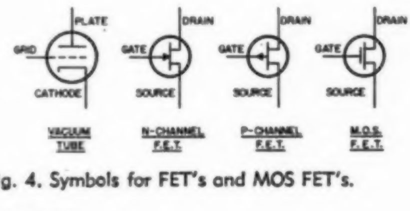


PLATE
GRID
CATHODE
DRAIN
GATE
SOURCE
DRAIN
GATE
SOURCE
DRAIN
GATE
SOURCE
VACUUM TUBE
N-CHANNEL F.E.T.
P-CHANNEL F.E.T.
M.O.S. F.E.T.

Fig. 4. Symbols for FET's and MOS FET's.

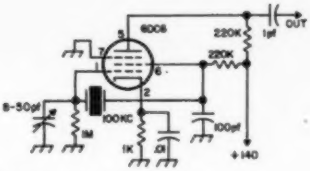

6DC6
220K
1pf
OUT
220K
5
7
1
6
2
8-50pf
1M
100KC
1K
.01
100pf
+140

Fig. 5. Collins 100 kc calibrator.

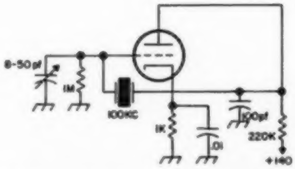

8-50pf
1M
100KC
1K
.01
100pf
220K
+140

Fig. 6. Triode equivalent of Collins 100 kc calibrator shown in Fig. 5.

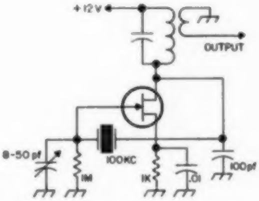
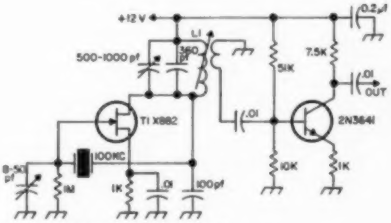

+12V
OUTPUT
8-50pf
1M
100KC
1K
.01
100pf

Fig. 7. FET equivalent of Fig. 6.


+12V
0.2µf
L1
500-1000pf
360 pf
51K
7.5K
.01
OUT
TI X882
.01
2N3641
8-50 pf
1M
100KC
1K
.01
100pf
10K
1K

L1 = SIEMENS 54T1 (O.L.) 1100N22 MATERIAL
38 T. PRIMARY, 4T. SECONDARY

Fig. 8. Isolation amplifier added to Fig. 7.

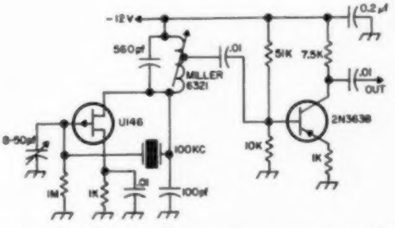

-12V
0.2µf
560pf
.01
MILLER 6321
51K
7.5K
.01
OUT
U146
2N3638
8-50pf
100KC
10K
1K
1M
1K
.01
100pf

Fig. 9. P-channel FET oscillator and isolation amplifier.

the control electrode and source of current carriers. **Fig. 4** shows the representations of FET's along with a tube symbol to demonstrate the likeness.

The N-channel is most like the vacuum tube because one applies positive voltage to its drain and negative bias voltage to its gate for amplifier operation. The P-channel types are the other way around with negative voltage on the drain and positive bias. (The MOS types—which stands for Metal Oxide Silicon—are still rather expensive for amateur use.)

To illustrate how one can go directly from a well-established tube circuit to an equivalent FET circuit, let's steal the 100 kc crystal calibrator from the Collins 75S1. The original is shown in **Fig. 5**, and its triode equivalent in **Fig. 6** (we must draw the *triode* equivalent since we are going to replace the tube with a triode device). The only difference between these two circuits is that the output coupling of the original (electron coupling) has been left out. Let us now, again, redraw the circuit substituting an FET and lower the "plate" voltage a bit to suit the E_{dss} of the transistor, as in **Fig. 7**.

A parallel resonant circuit for the desired oscillator frequency is placed across the "plate" load to allow sufficient dc to flow and to make a low impedance tap available for output.

The 8-50 pf trimmer capacitor can be adjusted a bit for each crystal to bring the oscillation frequency right to that which is stamped on the crystal can. In most cases, the output frequency will fall within the crystal tolerance with no adjustment necessary.

Since we had to dispense with the electron-coupling method of deriving the oscillator's output, it would be well to add some output isolation to this FET equivalent. This can be done by adding an amplifier stage, using a conventional silicon transistor, as in **Fig. 8**.

In the above example, the FET used was a Texas Instrument TIX-882, a germanium FET which was available for about $3.00 several years ago. This type (N channel) was used to allow the tube-circuit-conversion example to use a positive supply, for illustration purposes only. The TIX-882 is no longer available, but a silicon N channel FET could be substituted.

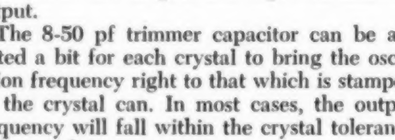


Fig. 10. A Butler oscillator as analysed by sections.

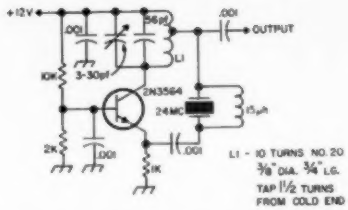


Fig. 11. In this circuit for crystals designed for series mode operation, an inductance is added in parallel to the crystal to resonate the holder capacitance and prevent spurious oscillation.

Since it is the P channel devices that are now available inexpensively (U146 and U147), **Fig. 9** shows the circuit (again redrawn) for one of these.

The main intent in the foregoing section was to demonstrate how one can use FT 171, FT 241, FT 243, and similar surplus crystals with FET oscillators so that they oscillate as marked. However, in the more recently available surplus, there are some crystals which *are designed for* series-mode operation. Military types in the HC10/U (coaxial) case are for series operation: CR9 and CR 24. Also, many of the crystals in the HC6/U (hermetically-sealed metal cases with ½" spaced, 0.050" pins) are for series operation: CR19, 23, 25, 26, 28, 30, 32, 35, 45, 51, 52, 53, 54, 65, and 75.

Some of these crystal units were designed for tube type oscillators of the "Butler" type, but will work well in the type of oscillators shown in **Fig. 2**. The Butler oscillator achieves the low impedance driving source and low impedance input by use of a cathode-follower and a grounded grid stage respectively. The Butler oscillator is shown in **Fig. 10**, divided into its component sections. As can be seen, V_1 is a Colpitts Oscillator whose capacitive-tap does not return directly to the cathode but drives V_2, a cathode follower. V_2 drives the cathode of V_1 through the low series-resonance resistance of X.

This method of utilizing the series-resonance frequency of a crystal with a tube circuit is the "hard way," although an equivalent FET Butler oscillator could be built. It is far easier to use a single bipolar transistor oscillator like one of those in **Fig. 2**. An actual circuit is shown in **Fig. 11**, for a 24 mc crystal oscillator using a CR 24 coaxial crystal.

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Slaying the Monster

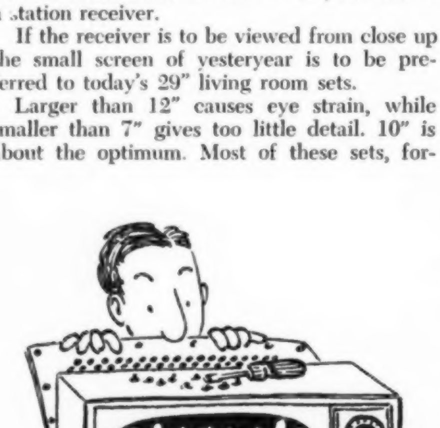
or: Why Fear TV?

WØKYQ wrote a fine book (Unfortunately out of print) describing a TV station which can be built for under $50.00. For many this book has already served as introduction to another fascinating facet of hamming.

Those of us who have been frightened by so many circuits completely alien to AM phone may be helped by the following description of how to rehabilitate an old TV set, for use as a station receiver.

If the receiver is to be viewed from close up the small screen of yesteryear is to be preferred to today's 29" living room sets.

Larger than 12" causes eye strain, while smaller than 7" gives too little detail. 10" is about the optimum. Most of these sets, fortunately, are still setting around in TV shops and basements waiting for us to collect them.



Wayne Pierce K3SUK

In selecting a set the main consideration is to make sure it has a power transformer, as the "series filament" sets introduce the same shock hazard as ac-dc table radios, even though they may be marked ac only. (This is due to a voltage doubler circuit in the power supply). Of course a set with picture tube is to be desired, but if it appears to be in good shape otherwise, a missing CRT is no reason to pass up a good deal. More on this later.

Once the set has been selected, proceed as follows, and little or no difficulty should be encountered.

If there is a chance that moisture may have gotten at the set place it under a 100 watt bulb over night before starting rejuvination. Start with a camel hair brush, and clean the set completely top and bottom. With the voltages involved, a single piece of lint can cause an arc, with possible damage to several components. Next look over the entire set carefully, and replace any tubular paper capacitors which show any signs of drying out or dripping. A good rule here is; when in doubt, replace it. An ounce of prevention is worth a pound of burned tubes and charred resistors. One word of caution, however, use exact values for replacement, and position them the same as the old part. Avoid moving parts unless absolutely necessary, then return them to their original position. The final step before applying power, is to take a good grade of solvent/lubricant (Quietrol, Spra-Kleen, etc.) and clean all switch contacts. The aerosol can is preferable, but a good job can be done with bottle and brush. Avoid using too much, as this will encourage accumulation of dust.

Do not touch any of the alignment adjustments, as these are set for a wide band width, and require special test equipment. Even the experienced TV technician attempts realignment only when absolutely required. These circuits are quite stable, also quite broad, so no trouble should result if they are left untouched. (The one exception is turret tuners, described later)

If there is no power cord with your set one can be bought at your local TV shop. It is known as a "cheater," and costs $.25 to .50.

Apply power and observe closely for arcing. If an arc occurs, turn the equipment off and clear the cause before proceeding further. Look for tubes not lighted, or with a blue glow, and replace any observed. If a known good tube still glows blue trouble is indicated, and must be cleared. This does not guarantee all good tubes, but it is a fair start. If all is well attach an antenna, and set the controls to a local channel. Adjust the fine tuning for best picture, then adjust horizontal and vertical hold controls for most stable picture. The horizontal and vertical linearity can best be set when a test pattern is being broadcast. Call your local station for the times such a pattern can be seen. Horizontal and vertical hold controls may interact with others, so always touch them up when changing other settings. Horizontal and vertical size may be set on the test pattern also, and should be adjusted so that height equals ¾ width.

When dealing with TV keep in mind that voltages as high as 40,000 volts may be present, so always discharge everything with a shorting lead before reaching into a set, and if it becomes necessary to take readings while the set is turned on, keep one hand in your pocket.

Picture tubes require special handling, as they contain a high vacuum and have a large exposed area, but with proper care no undue hazard is involved. Never bump or scratch a picture tube, or allow any pressure on the neck. NEVER leave an exposed picture tube where children can reach it. Replacement CRTs are available, usually at reduced prices, for all sets 7" or larger.

The image on a 12" or 14" screen can be reduced to the size normally displayed on a 10" screen (approximately 6" x 8") in many cases merely by adjusting the size controls. When this doesn't work take a strip of aluminum foil 2" wide and wrap one or two turns around the neck of the tube and fasten with Scotch tape. Slide this into or out of the yoke until the desired size is obtained.

If the set originally used a large screen CRT (up to about 17") usually it can be directly replaced with a 10" or 12" tube. The things to be considered are: 1. Focus—If the original used a focus coil and the replacement doesn't, replace the focus coil with a 20 watt resistor of about the same resistance. If the opposite is true connect coil anl control as in the diagram, or install a permanent magnet focusing device. 2. Ion trap—This is a small magnet on a clip, and may be installed by snapping it on the neck of the tube. Adjust it by sliding it around until a point is found that will give maximum brightness. If two spots give good brightness, use the one closest to the base of the tube. 3. Deflection—The yoke will probably give too much deflection. Use the aluminum foil trick described above. 4. Base connections—If the base connections of the replacement differs from the original, simply rewire the socket.

A good source of small screen tubes and other parts mentioned above is the series filament sets which we rejected for conversion, or your local wholesale house.

If for some reason the old cabinet does not make a satisfactory mount, a professional looking panel can be fabricated from tempered masonite or similar material.

If your set has a step type tuner it has been aligned on all channels, since the coils are all in series, and adjustment of one channel interacts with all lower channels. However, if it has a turret type tuner each channel uses a separate coil, and the unused channels (which will be used as the *if* in a ham set) probably have never been precisely aligned. In most cases it will still be close enough to function, but the purists (and the screwdriver technicians) may wish to touch up this adjustment. This requires a reasonably accurate signal source, but a well constructed self-excited oscillator can be used. (77.25 mc for channel 5, and 83.25 for channel 6) In recent years manufacturers have aligned all channels, so we have a ready source of calibration for our oscillator. Tune the family TV to the nearest (in frequency) channel in use in your area, and adjust the fine tuning for best picture. Switch to the channel to be aligned and couple the oscillator to the set. Tune the oscillator until the screen goes black. Set the oscillator to the center of the tuning range that will cause a black screen. Now connect the oscillator to the set under test. Under the channel selector knob is a hole which gives access to the coil in use. Set the channel selector to the desired channel and adjust this slug for maximum blackness of the screen, with the fine tuning set to mid-scale. This completes alignment.

Let's make BCNU a literal expression on the ham bands. . . . W0EDO

Looking west from the front of the VP2VD shack. The high peak in the background is St. Thomas in KV4 land.

John Attaway K4IIF
P. O. Box 205
Winter Haven, Florida
Photos by K4CAH.

Diary of a DXpedition VP2VD

During the period October 21-24, 1965 a DXpedition was made to the British Virgin Islands by Dave Gynn G3SBP, Ernie Hendry K4CAH, and the author, K4IIF, operating under the call VP2VD. Although each had previously operated from DX locations, this was the first effort on a concentrated operation within a limited time period. Naturally many unexpected problems arose, all of which were at least partially solved, so that the expedition reached a successful conclusion. These humorous and not so humorous problems, and their solutions, comprise an interesting account which everyone who has dreamed or planned toward a DXpedition will find interesting and enlightening.

The planning period

December, 1962

The idea originated 3 years ago while standing on the front porch of the home of KV4BZ. It was a clear bright day, and Jost van Dyke, Tortola, and the other British islands to the east seemed very close.

January-February, 1963

Regular skeds were kept between K4IIF and Dick Spenceley KV4AA, the grand old man of the Caribbean. However, it was quickly found that although Danny Weil VP2VB, could easily obtain a license as a British citizen, for U. S. citizens it was another matter entirely. No license could be obtained and the idea was set aside.

July, 1965

Rumors began to circulate of a pending reciprocal operating agreement between the USA and the UK. A letter was quickly dispatched from K4IIF to old friend G2BVN, DX editor of the RSGB bulletin. "What gives, Steve?"

August 15, 1965

K4IIF de G2BVN: "—— an agreement is now being negotiated between the U. S. and the U.K. and it should not be too long. —sorry I cannot offer you an immediate solution John, but I'll be pleased to keep you posted."

August 28, 1965

Ernie K4CAH, signed on as 2nd operator.

September 9, 1965

Reciprocal licensing was still very indefinite, but KV4AA came up with an ace-in-the-hole. Dave G3SBP, ex 5N2RDG, engineer for Cable & Wireless Ltd in St. Thomas, was sweating out the reciprocal agreement from the other side. Meantime he might be interested in a VP2 operation. Letter contact was quickly made.

September 21, 1965

K4IIF de G2BVN: "—we saw representatives of our GPO at the end of last week and the news is that the form of application and the necessary paperwork and checking organization for reciprocal licensing should be operational by the end of October."

This made it definite that reciprocal licensing would be too late for us, so the licensing burden fell fully on Dick Spenceley's ace, G3SBP, but there was no problem as Dave wrote "I have applied for a VP2V call and hope to get confirmation of it some time this week."

September 22, 1965

We were sure of a ticket, but what about a QTH? We had not been ashore in these islands. A land line call to ARRL Director Bob Denniston, W0NWX, revealed that his favorite retreat, the Treasure Isle Hotel on Tortola, had power 24 hrs. per day. However, Bob cautioned that it was surrounded by high mountains and that propagation was poor.

September 23, 1965

G3SBP de K4IIF: "We are rounding up gear. –can you get a pole for the beam? How much trouble is it to get from St. Thomas over to Tortola?"

K4IIF de Treasure Isle Hotel, Tortola, BVI: "We are pleased to confirm your booking from October 21-24."

September 25, 1965

K4IIF de G3SBP: "Re the pole, we should be able to get something in Tortola even if it is only 2 x 4's. We can't carry a pole or mast on the boat. There are 2 boats daily to Tortola, the trip requires 2 hours."

K4IIF de K4CAH: "Looks like you too are burning up the typewriter. – I have been promised a triband beam and possibly a Xmtr and Rcvr."

October 4, 1965

K4IIF de G3SBP: "The ticket is in hand. The call is VP2VD. However, they specify 200 watts maximum so no linear. Can get a 20 ft. pole, 4 x 4, at 21¢/ft."

October 8, 1965

K4IIF de K4CAH: "The gear loan fell through. I will box up my own personal S-line and take it. Can't locate the man with the beam."

October 10, 1965

K4CAH de K4IIF: "W4DQS has sent me one of the SX-117s used at San Felix, and I will take my SBE-33 and TO Keyer."

October 15, 1965

K4IIF de K4CAH: "W4PJG has volunteered to be QSL manager. Still unable to locate the man with the beam."

October 16, 1965

W4PJG de K4IIF: Ur offer to handle QSLs is gratefully accepted.

October 18, 1965

Beam finally obtained but too late to check it out. The beginning of a serious problem.

The trip down, October 20, 1965

The only serious travel problem arose when we met at the Miami Airport and compared notes on the weight of our luggage. It appeared that the airline would soon be holding mortgages on our respective homes to satisfy the overweight charges. However, by putting some items in the baggage of Sonny McCoy, a prominent citizen of Ft. Myers, Fla. who was going along to see the country, and by carrying a few light weight items, such as the power supplies, on board as hand luggage, we succeeded in scraping by with only a $40.00 charge. We then resolved to make good use of air freight on the return trip.

After meeting Dave Gynn G3SBP, for the first time at the St. Thomas airport we adjourned to the latter's jeep, and with K4IIF sitting on K4CAH and Sonny McCoy sitting on the TH-3, we drove to the QTH of KV4AA for a pleasant reunion over beer and supper. After eating, everyone took a turn at the mike of KV4AA before turning in for our last good night's sleep for several days.

The next morning, October 21, we arose early, ate a good breakfast, then drove down to the waterfront in KV4AA's truck to catch the morning boat to Tortola. The trip was beautiful, V. I. scenery being second to none. On the way over we got our first view of the highest peak of Tortola, not knowing at this time what role this peak was to play in our later operations.

The operation begins—but with problems

On our arrival in Roadtown, capital of Tortola, we found that October 21 was the local patron Saint's day, and all businesses were

On the dock at St. Thomas preparing to board the Empress of Tortola bound for the British Virgin Islands. On the left is Sonny McCoy, with Ernie Hendry K4CAH and the gear to his right.

closed. Consequently we couldn't get the pole we had planned to use for an antenna mast. However, the hotel was more than cooperative and allowed us the use of its 20 ft. flagpole, the top of which could be reached from the roof. No ladder was available, but G3SBP solved the problem by walking across an adjacent wall and climbing vines onto the hotel roof. Unfortunately, Dave's arms and legs became casualties when the vines turned out to have thorns.

Shortly G3SBP and K4IIF had the dipoles for 40 and 80 meters up while K4CAH worked on the assembly of the beam. The other hotel guests stood around watching in amazement and the owner of the local radio station, call letters ZBVI, was attracted to the commotion. After investigating the scene she dispatched a jeep to the station to secure a tape recorder for an interview. A 15 min. interview was subsequently taped and broadcast at 6:30 PM on prime evening time, a thrill to the DXpeditioners to outweight world tensions in the local news.

However, after this interesting interlude our problems became really troublesome. As mentioned earlier we had not been able to check out the beam prior to departure, and we found that the boom to mast bracket and the clamp joining the two halves of the boom were missing. It was later found that these had been removed as a practical joke. Different people have different ideas regarding fun. Despair momentarily took over, but not for long as a Rube Goldberg arrangement of ropes and wooden wedges was devised which held well enough to support the beam.

At 1925 GMT the S-Line was tuned up on 15 meter SSB and KZ5AY was worked for the first QSO of the expedition. Contacts followed with W4LZ and WA4LUG on 15, then a string of YV's on 20 meters. However, contacts to stateside were virtually non-existent on 20 even after long CQ's. The reason appeared obvious. The beam was looking directly into the side of an 800 ft. mountain rising almost vertically between the hotel and the USA. A gap in the mountain allowed us to skip over to YV and KZ5, but Bob Denniston was right, propagation to the states was hopeless. We were ringed on 3 sides with only the southeast completely open.

As daylight waned, Sonny and Ernie elected to climb the mountain in an attempt to find a solution to our dilemma. However, after 2 hours they came limping back into the hotel with nothing but bee stings, scratches, and the news that right behind this mountain was another one even higher. With this we QSY'ed to the hotel dining terrace for a delicious supper, typical of the excellent meals put forth daily by the Treasure Isle during our visit.

After supper K4IIF tuned up on 40 meter CW and kept a sked with Bill K4CK, in Auburndale, Fla. for the first CW contact. During the QSO the line voltage fluctuated so severely that the lights became very dim every 2-3 minutes. This rendered the automatic keyer almost inoperable as it went wild during the dips, sending dots when the dash lever was struck. We sounded like the worst lids on the band and finally had to go to a straight key. Afterward, 19, 40 meter CW contacts were made with the states and Europe before a violent thunderstorm forced us to QRT. During this time we had a pleasant visit with Row Roy VP2VA, proprietor of the hotel, who promised us help in the morning to get the beam higher.

The early morning 7 mc SSB sked with KV4AA, W8EWS, and K5JLQ was kept at 1150 GMT, following which, true to his promise, VP2VA arrived with a 15 ft. section of pipe, and shortly we had the flagpole extended higher. Everyone scurried to the rig, tuned to 14 mc SSB, and QSOs followed with W4ZYS, W4PJG, and numerous Central American stations. However, at about 1315 GMT the band quieted and we settled back to a pace of only 4-5 contacts per hour. At 1815 GMT K4KDN was worked keeping intact the record of contacts between Herb and K4IIF from every DX location visited by the latter to date.

We were now convinced that the DX'pedition would be a complete failure unless something drastic was done. The CQ DX Phone Contest was due to begin in a matter of hours and it would be our last chance to run up a respectable number of QSOs. Consequently, K4CAH set out to find a portable generator for rent while G3SBP called on John Horne of Cable and Wireless Ltd. for help in selecting a new QTH. John suggested looking at the site of a new tropospheric scatter station being constructed by Cable & Wireless Ltd. on the highest peak of the island, about 1500 ft. above sea level. They made a quick inspection trip and Dave returned ecstatic over the location which was unobstructed in all directions. The only disadvantage was the road, 5 miles of which were designated jeep only, daylight only.

In the meantime Ernie had found a generator for the "nominal" rent of $20.00 a day. We later found that it normally rented for $5.00, but the jolly Americans got a special price. Not impressed by the decrepit appearance and cough-sputter of the generator, it

The author beside the shack. Generator is in the foreground.

was decided to hedge our bet by splitting up. K4CAH and G3SBP went up the mountain with the S-line and dipoles for 20 and 80 meters while K4IIF remained at the hotel with the transceiver, SX-117, the beam which was not movable, and the 40 meter dipole.

Upon arrival at the top, Dave and Ernie quickly set up shop in a small wooden shed built as the construction superintendent's office. As soon as they tuned up on 20 meters they had a pileup. Whereas 5 contacts per hour were being made at the foot of the mountain using the beam, the dipole at the mountain top was yielding up to 2 QSO's per minute, alternating roughly 50-50 between stateside and DX. Contacts with Europe, N. America, S. America, Africa, and Australia were made in the first hour. The first stateside QSO was with Herb W4KET in Ft. Myers, with Jim WA4DDG, in Tampa right behind. Between 2015 and 2300 GMT over 250 contacts were made for an average of better than 80 per hour.

Contact was established with K4IIF at the hotel and plans were made to bring up the rest of the gear and some food. However, with sundown approaching no one could be found who was willing to tackle the road up the mountain with prospects of returning in the dark. Things looked discouraging until John Horne arrived at the hotel about 2200 GMT and agreed to take the Land Rover up one more time. The vehicle was hastily loaded and as a consequence the 40 meter dipole was left on the ground at the hotel. The only food which could be secured was a loaf of bread and some cheese plus a few cans of beer.

The Land Rover reached the summit at 2300 just in time to catch the last few minutes of the short tropical twilight. After quickly unloading John went back down the mountain leaving us completely isolated until the next morning, the nearest native cabins being about a mile away. However, that first evening must go on record as one of the most beautiful ever experienced. It was a dark, moonless night, and St. Thomas lighting up like a Christmas tree 20 miles away across the water, and the glow of the lights of San Juan 80 miles way will long be remembered.

The CQ phone DX contest, October 23-24

After 4 wonderful hours on 20 meters the band had begun to sputter and fade as 0000 GMT and the contest approached. However, we decided to stick with this reliable band and K4CAH took the first turn at the mike while G3SBP and K4IIF madly scurried around converting the 80 meter dipole to a combination 80-40 meter antenna by inserting insulators and jumper wires 33 ft. on each leg. This normally simple job was complicated by darkness interrupted only by weak light from a very sooty lantern. The band held up just long enough for us to complete the antenna conversion as Ernie logged in 9 countries in 5 zones during the first 16 minutes. These ranged from YS2SA in zone 7, our first contest contact, to OE5CK in zone 15.

Twenty really began to fold at this point and QSOs became few and far between. Consequently, the mike was relinquished to the author who QSYed to 7095 kc and went to work on the stateside pileup. The first contact was at 0049 GMT with WA2SFP. Over the next hour 31 contacts were made with W1, W2, W3, W4, W5, W8, W9, and VE. The going was slower than we had anticipated for two reasons, one being that we were frequently QRMed by other DX stations operating near 7095, and the other was the trouble in distinguishing the stations calling us from those calling other DX stations. Most of the DX was "listening 7200 up."

At 0200 another try was made on 20 meters but signals were few and weak, and only 2 contacts could be made so the insulators were jumped to convert the duoband dipole to 80. This job will long be remembered by K411F and K4CAH who climbed the wall of the partially completed building in pitch darkness to attach the necessary wires. It was resolved at this point to have a flashlight for the next night.

The first QSO on the 80 meter band was with W1AQH at 0246, after which 4 countries in 3 zones were worked in about 20 minutes. It was then discovered that the gasoline supply was diminishing at an alarming rate and would be exhausted before the morning band opening if not conserved. Accordingly, we shut down for an hour and attempted to rest on the floor of the shack with a roll of blueprints for a common pillow. Upon recranking the generator at about 0400 we found to our surprise that 20 meters was wide open to the midwest states. In a frantic hour from 0416 to 0516 K4CAH logged in 82 QSOs. These included 32 W0's, 24 W8's, 13 W9's, 6 W5's, 1 W4, plus KP4, KV4, OD5, ZE1, VP2, and ZS4.

At midnight we got an unexpected visit from Colin Barnes, hotel Asst. Manager, and Peter Keen, English freelance photographer, who braved the mountain road in the dark to see that all was well with us. G3SBP elected to return to the hotel with them so that at least one of us would be rested for the next day's operations.

After 0530 the going got rough again on 20 meters and only 1 DL, 2 4X4's, and a VE were worked in a 45 minute period so at 0625 we again QSY'ed to 80 meters, and in 28 minutes worked 19 stations in 4 countries and 3 zones. At 0650 the gasoline supply had us really scared, however, and we shut down for a second time.

At 0907 we again went back on the air after a totally unsuccessful attempt to sleep on the hard floor. We logged in 9L1HX and ZS1DG on 20 meters before trying the 40 meter pile again at 0916. During the next hour we made 37, 7 mc contacts in 5 zones and 4 countries. The number of DX stations using this band and tuning "7200 up" again lowered our contacts per unit time ratio. The bedlam around 7200 kc must be heard from the DX end to be appreciated, and equally so the 3800 up segment, as almost all stateside stations are on these frequencies during the late night and early morning hours.

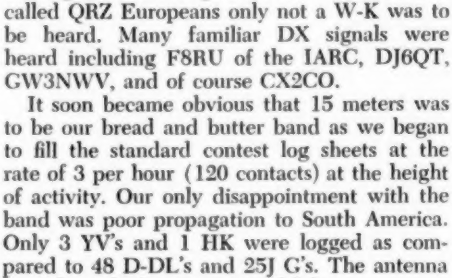
At 1028 we were again on 20 meters working LA3AF, after which 6 more countries in 3 continents quickly followed. To our surprise WA2SFP, who had been our first 40 meter contact, called us S9 at 1043 and the stateside parade was started much earlier than expected. The first from other east coast call areas thru the pile were W1BPW, W3AZD, and W4BVV. At 1058 W6HST was worked for the first 6 on 20 meters. At 1100 the Florida DX Club gang began to hit with rapid fire contacts by K4HNA, WA4NGO, WA4-DDG, K4SHB, et al. From 1043 until 1230 GMT 4 pages of log were filled at 40 contacts per page. These were mostly W, K stations, but many DX reliables such as GW3-NWV, OA4KY, KV4AA, HK4EB, YV5BIG, HC5CRC, and VP3HAG were also represented.

At 1230 the morning jeep arrived with a fresh can of gasoline and that crisis was over. We found much to our chagrin that the generator had been leaking gas all night and that if we had had a flashlight we could have fixed it and operated continuously. "For want of a nail the horse was lost."

At this time we crossed all fingers and tuned to 15 meters to find out whether a 40 meter dipole fed with RG58AU coax would load and get out at all. We were particularly dubious since the wire was stretched from NE to SW putting Europe directly off the end. Much to our amazement, our first CQ brought an immediate answer from OE3WWB after which a wonderful pileup developed. Ten countries in 5 zones were logged on the first page of the 21 mc log. Here it *must* be stated that the courtesy of the W, K operators during this time was phenomenal. Frequently, S9 + W stations alerted us to S4-5 European stations buried under the pile and then stood by while we worked the Europeans before making their own QSOs with us. When we called QRZ Europeans only not a W-K was to be heard. Many familiar DX signals were heard including F8RU of the IARC, DJ6QT, GW3NWV, and of course CX2CO.

It soon became obvious that 15 meters was to be our bread and butter band as we began to fill the standard contest log sheets at the rate of 3 per hour (120 contacts) at the height of activity. Our only disappointment with the band was poor propagation to South America. Only 3 YV's and 1 HK were logged as compared to 48 D-DL's and 25J G's. The antenna must have had some unusual lobes.

The contest to this point had been exhilarating though sleepless, the only objections being the rather monotonous diet of bread and cheese which we had obtained on our last minute dash up the mountain. While fresh op G3SBP, who had returned on the morning jeep, busily



Looking toward the British Virgin Islands from the bow of the Empress of Tortola. The highest peak was the location of VP2VD during the DX contest, October 23-24.

logged in 15 meter contacts a makeshift 10 meter dipole was constructed out of bits and pieces and hung just outside the shack. Due to the shortness of the feedline the 28 mc antenna was so low that members of the party had to stoop to walk under it. However, at 1345 we loaded it up and results were superb, proving again that if you can't afford a good antenna buy a mountain top QTH. The first forty 28 mc QSOs required exactly 20 minutes as we developed a vertiable pipeline to W8 land. Sixty-two W8's were worked on this band compared to only 39 W2's and 29 W4's. VE3LZ was worked to be the first station to QSO us on all 5 bands. Unfortunately the skip was short and although we had high hopes for 6 land contacts on 28 mc we made no QSO's with the Californians. One KS6 slipped thru on very long skip.

Just before noon K4CAH and K4IIF hitched a ride to town on a passing land rover leaving G3SBP alone on the rig for a 3 hour period. A cold shower, a delicious lunch sans cheese, and a 30 minute nap really filled the bill before heading back up the mountain fortified with bed spreads and cushions to make the shack more livable. The afternoon climb was courtesy of Row Roy, VP2VA, in the hotel land rover. On arrival Dave was found busily logging in QSO's while the generator coughed and sputtered, but ran on. Loss of the generator was a continual worry but despite dire predictions to the contrary it continued to function until the operation was concluded. During the afternoon a steady pace was maintained on 15 meters until about 2140 when contacts became thin and we shifted back to 20. The QSO rate on 20 was satisfactory but it was obvious that absence of the beam was hurting us. Despite the 5/9 reports being sent to us we were too easily QRM'ed by adjacent splatter in the 14110 kc area.

The 14 mc operation continued until past 0000 GMT but the nice opening to Europe of the previous day was not repeated. Most all of the contacts were with the states except for a sprinkling of VE, YV, and central Americans. By 0100 the pickings had become so slim that we returned to 40 meters. At this juncture we hit the worst doldrums of the contest as only contacts could be made in 30 minutes. These were all W2's except for Foy W4RLS, who struggled through giving us a 3/3/40. Thanks ole buddy, we were needing them about then.

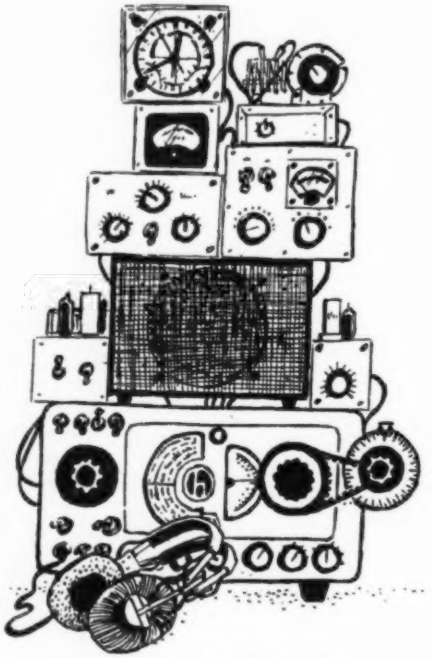
At 0200 we gave 80 meters another whirl and worked DJ1JW who was 5/9++, but was the only European heard. Would like to get a look at his skywire. The 3.8 mc band sounded real good and a lot of stations were calling CQ contest but after a return of only 6 QSO's in 40 minutes we again QSY'ed to 20. However, we could only make 12 contacts in the succeeding 2 hours on 20. At this point K4IIF and K4CAH, who had been either operating, logging, or working on the antennas for 42 consecutive hours minus the 30 minute nap at lunch, collapsed in a dead stupor and slept for over 5 hours. Dave carried on during the night but the bands were extremely erratic and did not pick up again until 1040 GMT when DX stations again began to roll through on 14 mc. A good opening to Europe was experienced including 3 consecutive OH3's at 1122-26. A few W4's were worked around 1145 and then we QSY'ed to 15 meters.

Conditions on 21 mc the morning of the 24th were quite good and many additional European stations were logged. However, the contact speed was a little slower as so many had been worked the first day. A short 10 meter break was taken from 1250 to 1255 to work two ZS, a ZD8, and a KV4, and then we retuned again to 15 meters. By 1300 more W-K's were being worked than Europeans, but DL's, G's, and SM's continued to mix it up and OH0NC was worked at 1359 for an unexpected multiplier. By 1420 we seemed to be in less demand on 15 meters. Whether this was propagation or not we didn't know, but we QSY'ed to 10 meters and resumed our pipeline operation to the states, making 56 contacts in 40 mins. before taking up the 21 mc battle again at 1500 to fill 4 more log sheets.

At 1800 we QSY'ed back to 28 mc for the last go round, having learned that the last possible ride down the mountain would be at 2000 GMT, a heart-breaking 4 hours before the contest was due to end. However, the last 2 hours were used to good advantage as 5 and ½ more log sheets were filled with 10 meter QSOs at a rate of about 110 per hour. At 1951 it was up to K4IIF to make the last contacts, K4JEY and then VE3FYF, before saying the hardest 73 ever to a still crackling band. By 2000 all antennas were down, loaded on the land rover, and the last trip down the mountain had begun.

The VP2VA group would like to thank the staff at the Treasure Isle Hotel, particularly J. R. Roy VP2VA, for cooperation far beyond the call of duty; and the personnel of Cable and Wireless Ltd., particularly Mr. John Horne and Tony, for their help in allowing us to use the facilities under construction at the Challwell Tropospheric Scatter Station. May we be in position to help you some day.

. . . K4IIF



Illustrated by Wayne Pierce K3SUK

Un-modifying the S-38

David Bartley WA5MCU
1815 W. Wildwood
San Antonio, Texas 78201

One disadvantage to subscribing to 73 magazine seems to be the fact that once a month, every month, one is faced with an overpowering urge to BUILD something.

Usually, when my copy arrives in the mail, I carefully read the editorial, while trying to overcome the urge to drool over all the construction articles. Unfortunately, this seldom works, and I soon find myself going through the catalogs with a pencil in one hand and an order blank in the other, attempting to determine the cheapest project in the book. Once this is found, I eagerly go to work, happy to be working on something, whether I need the finished project or not.

It would appear that I am not the only ham with this unusual addiction, for 73 seems to be flourishing, with better articles in each new issue. However, there comes a time when all those projects pile up.

This happened to me when I finally decided to get a better receiver. A deal was quickly made with the local dealer whereby he would give me a nice, shiny HQ-110 in trade for the last of my savings and my dilapidated S-38. Unfortunately for Hallicrafters, I had ruined their little SWL-type receiver while I served my time as an SWL, and so I had to modify it for acceptable use as a ham. Enter 73, lots of parts, and a few headaches.

It appeared that I would have to put the old receiver back into something resembling its original condition, or I could never trade it in. This was a crisis. I turned to 73. Unfortunately, 73 is full of modifications, but practically devoid of UN-modifications.

It finally occurred to me to take the instructions I had used to modify the receiver and simply apply them in reverse. Armed with several issues of 73, the Handbook, two equipment manuals and an unsoldering iron, I set to work.

First, I disconnected the external Q-multiplier and set it aside. Then I disconnected the external speaker, and hooked the built-in one back up. The next thing to come out was an extra *if* stage I had added outboard. Then I removed my BFO, and replaced the gimmick in the *if* for use as a BFO. The next step was the replacement of all my 6 volt tubes with the original AC/DC types, the removal of the power transformer, and the re-installation of the shock hazard. The OA2 quit glowing when the original low B+ was produced, so I took it out, too.

About this time, the chassis was getting to be almost uncluttered. It was a simple job to replace the rf gain pot with the old standby switch, although that slide switch looked rather out-of-place in a round hole. Next to be pulled was the CW noise limiter, and this really presented a problem. The clipping level pot had gone in a hole that wasn't originally on the front panel. How was I going to fill in the hole? With typical ham ingenuity (sneakyness), I took a big bolt and a couple of washers, and put a knob on it. It filled the space beautifully, but everyone wanted to know why the knob wouldn't turn! This was solved by filing a groove in the bolt for the knob's set screw to ride in. Now the knob turns freely on the bolt, doesn't fall off, and doesn't cause any embarrassing questions.

With this problem solved, I was almost through with the project. Quickly I removed the external phone jack and rewired its connections to tip jacks on the rear panel. Then I removed my vernier dial mechanism from the bandspread tuning shaft, and discon-

TRADE SPECIAL

nected my RME preselector at the antenna terminals. A quick alignment job finished it up.

On the way to the radio shop to get my new receiver, I suddenly remembered the Rate-of-Change ANL sub-chassis I had installed. I quickly drove into a side street, stopped, pulled the receiver out of the cabinet and pulled out the noise limiter module. I looked everything over again, and saw that I had left my simple fixed squelch circuit in to cut down noise. That was easy to take out as it consisted of only two resistors. Another look and I noticed I still had a 1N34 as a detector, although I had replaced the 6SL7/1N34 of amp/BFO/detector with the original 12SQ7. Quickly I removed the diode and ran the wire over to the 12SQ7 socket. Then I hurriedly put the receiver back in its cabinet before I found something else to unmodify.

Finally the moment of decision was over—the dealer had reluctantly accepted my butchered trade-in, and I was the proud possessor of a new HQ-110.

On the way home, I merrily whistled a tune, and began thinking. I still had that outboard Q-multiplier. Why not put it on the 110? And that CW noise limiter would also be useful. And the phones jack would be much more convenient on the front panel. . . .

The following day, my next issue of 73 arrived.

Can anyone give me any advice on UN-modifying the HQ-110? I just saw a real nice SB transceiver, and . . .

. . . WA5MCU

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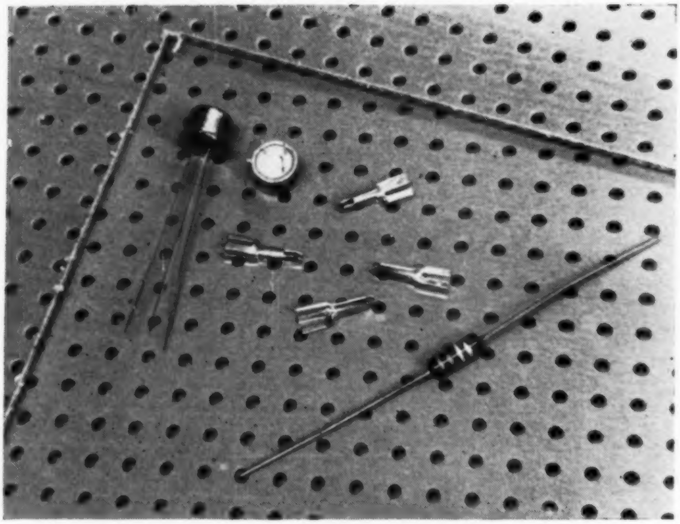
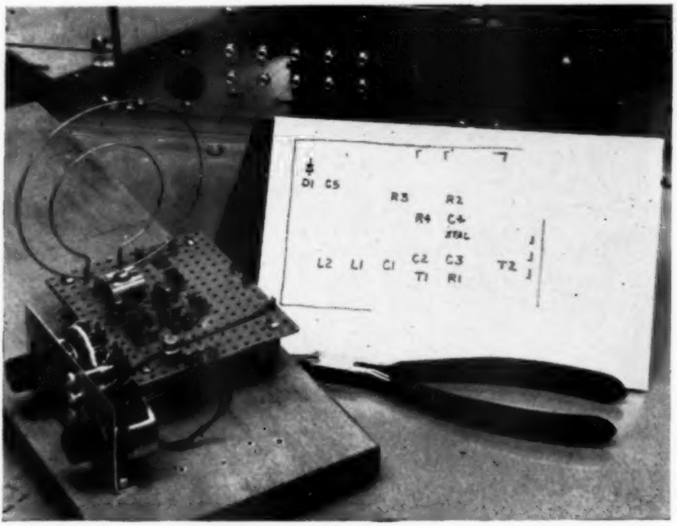


James Ashe W2DXH
R.D. 1
Freeville, N.Y. 13068

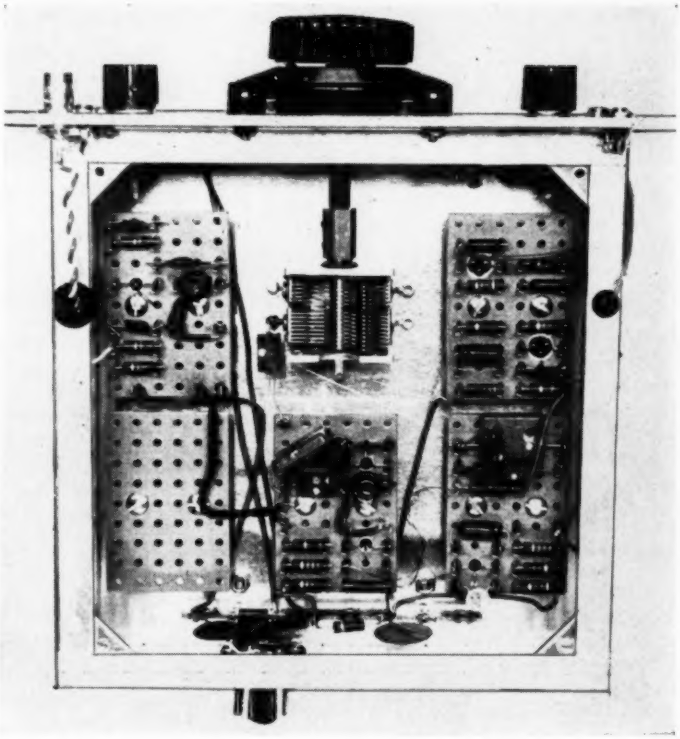
Vector Vector

Here is a way to make electronic circuits and boards that really look good. It is ideally suited to small-signal solid state circuitry and requires no special tools or chemicals. Once wired up, sections can be changed or rewired if necessary.

This style of construction uses a special punched board and clips supplied by the Vector Electronic Co., Glendale, California. Allied and Lafayette are two well-known dealers carrying Vector products.



A small layout chart and the board built from it.



A simple transistor receiver built from Vector board modules. Each module has one of the basic circuit functions on it. The modular construction makes it easy to make changes when desired and also provides needed circuit isolation.

Materials

There are two basic families of Vector board and clips. This article describes the larger variety. The board used is available in phenolic, epoxy-paper, and epoxy-glass materials, in 1/16" and 3/32" thickness with .062 and .093 inch holes in several different patterns. Sheet sizes range up to 19 x 35 inches.

For most work, 3/32" board is preferred because of its greater stiffness. I have found the ordinary phenolic board adequate for general usage. It is punched in Vector's pattern A, with .093 inch holes on .265 inch centers across and along the board. For greatest economy, the board is purchased in large pieces, such as Vector's #64AA32, 8.5 x 17 inches.

Two similar mounting clips go well with this board. Of the various types listed in Vector's catalog, the best seem to be their #T9.4 and and #T9.4A lugs. The T9.4 has a slot with teeth; the T9.4A gets along without the teeth but is otherwise similar. I prefer the T9.4A lugs because components are easily changed.

The clips are made of brass with a tin finish. They are rather springy, but bendable. A single slot at the bottom takes up to three ends of #22 wire, and two slots at the top take component leads. In general, the clips are not reusable.

If these clips are mounted in a 3/32" board, they will project about ¼" from the component side, and slightly less from the wiring side. The minimum clearance required to avoid shorts is an eighth inch or more depending on component sizes, distance between mounting centers, possible shock and vibration, etc.

Layout

Small circuits are easily built without going into the detailed procedure described below. This is the Gung Ho Class One process, suited to making computers and such. Lift from it what you want! As you become accustomed to it, you will find additional ways to avoid confusion and mistakes.

One side of the board is arbitrarily labeled 'components'. Imagine or mark a line on one long edge; when you want to look at the other side of the board, turn it over that mark as over a hinge. Then the top goes to the bottom, but left-to-right relations remain the same.

The layout must be planned before starting construction. Each component is labeled, R1, C5, D15, etc.; parts near each other in the circuit being given numbers near each other. Then these part numbers are written on a chart as the parts will be arranged on the board, with due allowance for large capacitors or other components. This will be hard to do, first time. Each diode site is marked as to which way the diode points, resistors are situated with either left or right hand ends going to supply voltages, and the natural function of the circuit proceeds from left to right. After you have built a few boards, all this and lots more becomes habit. Start small.

Board preparation

When the planning is done, you're ready to start building. First you take your board . . .

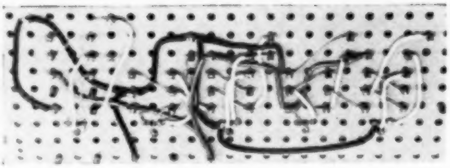
The hard plastic materials tend to be brittle. The fiberglasses are tough, but they will tear. You must cut or file, but not shear, to get the shape you want. A bandsaw is a very good tool if the correct blade is mounted on it. With care, patience, and the good word from an old machinist you can use a bench mounted saber saw. Not recommended for beginners. If cutting with a hacksaw, the work must be supported near the cut or it will bind and perhaps break.

Cutting lines are marked by scribing along a straightedge. For a good edge the cut should be off center because the blade will take out about one sixteenth inch. The cut can be made most accurately if the scribed guideline indicates its edge. Try to cut from stock so as to leave the best piece for future supply.

Rough edges left after cutting are best removed with a file. Mount the file in a vise and move the work—touch up the corners too.

Clip installation

After the board is prepared, the clips go in. They must be installed one at a time, and it's a little hard to do. With a pair of long-nose pliers, grasp the large end of the clip, place the small end in the hole, and push it in. If the clip isn't square to the board, it won't go. The number required is about two per component, so you will shortly master the trick.



The back of a Vector board project. Much of the wiring is done with bare wire since it's easier to use. Longer runs, or cross-overs, must be done with insulated wire to prevent shorts.

Because the slots are off center, the job looks best if all the clips face in one direction. This makes imposing arrays. Don't be afraid to lay out different parts of a large board in different ways!

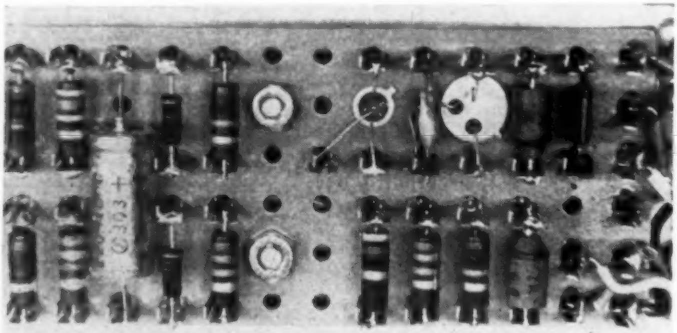
When you turn the board over, it will look like Kipling's jungle. If you did your layout as described, remember that left-right relations are the same, top-down on the layout has become bottom-up on the board, and left-hand terminals take supply leads. The picture will clear up rapidly.

Wiring

All wiring is done with #22 solid hookup wire. For simple boards and connections between adjacent clips bare wire is easiest; for longer runs Teflon spaghetti is best, but I can afford only thermoplastic insulation.

I have a nice-sounding system used as a guide in wiring up large circuits with least confusion: It goes like this:

1. Chassis-ground wiring, white insulation.
2. Positive supply insulation, orange and red.
3. Negative supply wiring, gray and black.
4. Emitter, base and collector wiring, yel-



Closeup of a small board showing one way to mount transistors.

low, green, blue respectively.

5. Signal wiring, violet.
6. Finish up where required.

Those are the rules. I make a reasonable effort, no more, to follow them. After all, the goal is a circuit, not an illustration.

Component mounting

Components are mounted by pressing down into the clips, which may require a little bending to hold well. For test purposes there is no need to solder the components in, but you should be careful that they are tightly held. Diode and electrolytic capacitor sites should be marked to indicate direction, with something a little more permanent than ink.

Transistors may be mounted several ways. The plastic board has no heat dissipating properties at all so you must use a sink for anything that runs hot. If you are working with small signal transistors, a nice way is to bore a hole just large enough to take the leads, place a clip on each side, and run the emitter and collector leads to these clips. These hold it in place. A slightly larger hole will take a socket, which may be held in place with some epoxy or a super glue. Celluloid cement will be too weak.

If you're brave, the circuit is trustworthy, and the transistor is sure to be good, there's absolutely nothing better than wiring it in. You can rely on solder connections to stay made. It's a good feeling.

When everything is working properly, the clips may be soldered. Easy on the solder, and work fast. The very short leads can carry lots of heat into resistors and capacitors as well as transistors and diodes.

Soldering guns are far too clumsy for this work. The best tool is a small iron of modern design, operated from a Variac or series resistance to reduce its temperature to no hotter than the job requires. An isolation transformer might be good insurance, because some irons are leaky enough to light up a neon lamp! Try it and see.

Feedback

With their low input impedances, transistors aren't much troubled with feedback problems. But low impedances tapped into tank circuits become high impedances! And this type of construction isn't remarkably low on circuit capacitance, although careful layout and a little distance between sensitive points will generally be adequate. The extreme approach is to break up the overall circuit into subcircuits, each on its own board, and put shielding between where required.

. . . W2DXH

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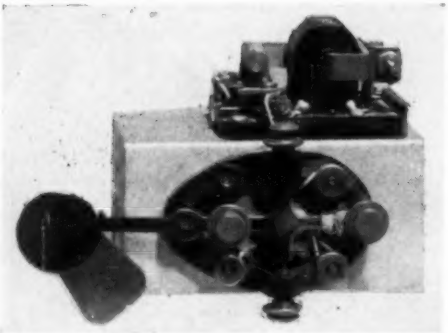
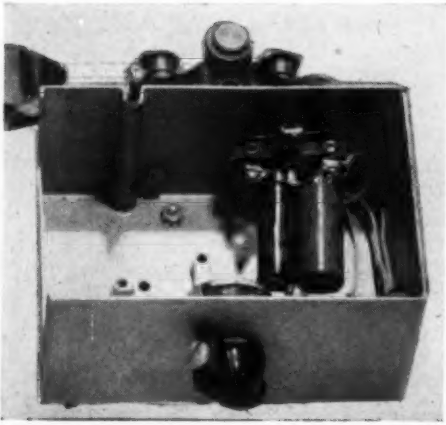


Side view of the Cathkey. Construction is completely non-critical.

Cathkey

A Cathode Powered Cathode Keyer

Henry Meiseles K2UOC
1523 45th Street
Brooklyn, N.Y. 11219



Interior of the Cathkey.

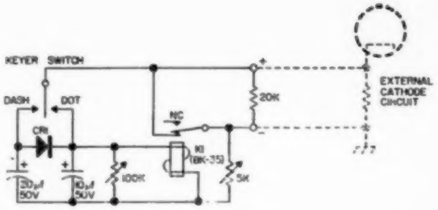


Fig. 1. Schematic of the Cathkey.

The Cathkey is an adaptation of the Corkey tubeless electronic keyer[1]. The essential feature of the circuit is this: Cathkey derives all its operating power from the keyed source itself. Just plug it into the key jack and that's it. No reduction of transmitted power occurs since the keyer draws power only during the key up intervals.

The circuit functions in the following manner:

1. Assume the keyer switch is placed in the dot position. This places the 10 µf capacitor, 100 K potentiometer and relay K1 across the external cathode circuit through the 5 K current limiting pot. In this dot position, the 20 µf capacitor is isolated by diode switch CR1; placing the keyer switch in the dash position places the 20 µf capacitor in parallel with the aforementioned components increasing the RC time constant for the dash cycle.
2. K1 becomes energized, forming a ground return path for the external cathode circuit through its contacts. This keys the transmitter and simultaneously shorts the cathode potential which supplies voltage to the keyer circuit.
3. The stored energy in the capacitors maintains K1 in its energized state for the duration of the time constant which is determined by the fixed values of the capacitors, K1, and the variable adjustments of the 100 K speed control potentiometer and relay contact spacings.

Upon capacitor discharge, K1 de-energizes and opens the cathode ground path. If the keyer paddle is held in a contact position the cycle of steps will be repeated. The circuit is of the self completing type.

It was found that relatively high values of the capacitors tended to shape the keyed waveform. However, the resulting CW note was not unpleasant to listen to.

. . . K2U0C

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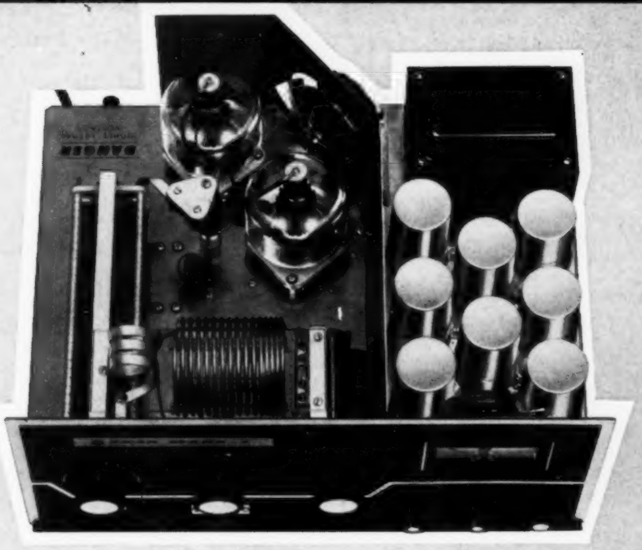
[1] "Tubeless Minikey," QST, November 1961.
"Corkey-A Tubeless Automatic Keyer," QST Hints and Kinks, 1954.



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All Solid State

While some applications are particularly suited to transistors (low voltage-high current power supplies, for instance), the application of power transistors to a regulated 150 volt plate supply for vacuum tubes, described here, is neither simple nor inexpensive. The semiconductors for an all-solid-state version cost about $20, but by employing a VR150 or OA2 for the 150 volt reference it is possible to save about $6. A VR breaking down at 85 to 110 volts can be substituted for the other protective (zener) diode at a further saving. This worked fine until I cracked the glass on the one that I was using and blew another transistor. I decided that it was worth a few extra dollars not to have that happen again.

The original circuit was carefully tested in the laboratory using the arrangement in Fig. 1. So far as we could find out, everything was excellent, except that the limited breakdown voltage of the transistor used made for some loss of regulation under abnormally high line voltages.

Fig. 2 shows the final version of the regulator. The differences are not all obvious, but the pitfalls that I encountered at $4.50/pitfall (it wasn't just the money, my morale also got very low) explain the added parts.

1. During tests, a cliplead shorted. Before the next time, we inserted the fuse and 15 ohm resistor.

2. When the regulator is feeding a capacitive load, the charging transient is about as bad as a shorted load, and when the OA2 fired abruptly in the circuit of **Fig. 1B**, there was high voltage across the pass transistor at the same time there was reverse voltage on the base. (For why this is bad, see the Motorola Power Transistor Handbook under "second breakdown".) The 15 ohm resistor and the 1N3340RA protective diode handle this. An OC2 may not be a good enough protective shunt, in that its internal resistance is about 100 ohms, compared to the 15 ohms in series with the breakdown characteristic of the transistor (negative resistance for some types, about

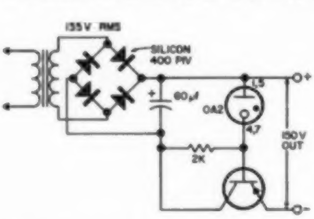

Fig. 1A. Simple circuit. Blows transistors.

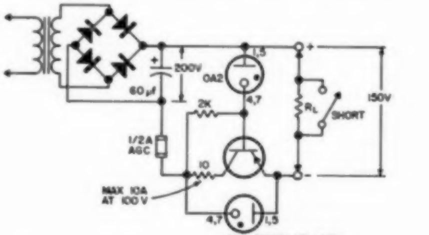

Fig. 1B. Over-current and over-voltage protection.

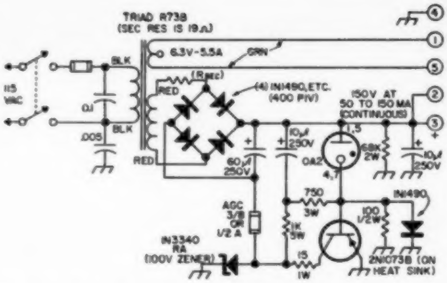

Fig. 2. Complete power supply. Heat sink is Astrodynamics 2505 or Delco 7270725, or Astro 2504 mounted against chassis by a sheet of .005 Teflon or Mylar.

Table I

Current in ma	Volts	Volts rms ripple
10	147	.014
105	147	.060
200	146	.160
450	135	1.00

zero ohms for the 2N1073 series.) A lower power rating might be okay for the zener, but would only save about two dollars. I played it safe.

In a further effort to reduce the turn on current surge, the 10 µf capacitor in the lead to the VR tube and transistor base was installed. It also reduces ripple.

3. When a standard alloy type having high breakdown voltage was used for the pass transistor, it blew immediately, from collector to base breakdown. The DAP structure of the 2N1073B has low reverse breakdown between base and emitter; a silicon diode across this junction was added to protect types with higher BVebo. A 100 ohm resistor was also inserted, to insure thermal stability in the event of a defective or out-of-socket OA2.

After this last change, the circuit was that of **Fig. 2**. The Triad R73B transformer is ideal for a silicon bridge rectifier; its 19 ohm series resistance being high enough to limit the surge current to a safe value for most common receiver type silicon diodes. The 5.5 amp filament winding is adequate for several converters or a receiver plus converter. The DC rating is 200 ma total, substantial for so small a transformer. The last transistor inserted has survived for eighteen months, about a thousand hours and two hundred cold starts, so I think the problems are licked. If you want to try to make one like it, go ahead, but any modifications are at your personal peril; all I'm sure of is that there are possibilities of disaster in the simplest circuit.

. . . W1OOP

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QSL Here is Homebrew, OM

Every year, in thousands of new hamshacks, this scene ensues. The Novice sends away to all the QSL printers that advertise in 73, QST, the Callbook and Popular Electronics. Then, amid samples of stock, print styles, cartoons, illustrations and doo-dads, the new ham "sends away" for the card that expresses his personality . . . 96 point callsign, as in the WA6XXX card, superimposed on the schematic-diagram background, as in the WA5XXX card, with overside fill-in data as in the ZD10AA card.

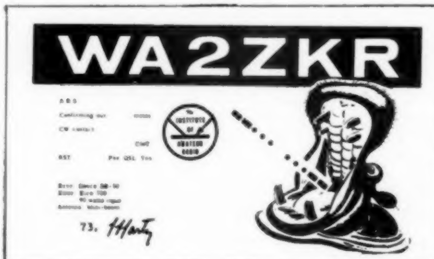
The January '62 issue of 73 had a good article on making QSL's for club members. The idea was that all the members could chip in to pay for an artist's design which would then go on all of their cards. This approach is fine if you don't mind carbon copy cards and belong to a club. If not, it's not.

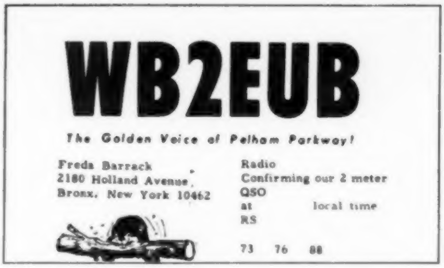
Many DX QSO's take less than a minute; the really rare ones run about 20 seconds. Your personality is your QSL. And when you're angling for a rare card or overseas friendships you won't cut ice with a carbon copy card. An original, imaginative card will stay on his wall and get you his card in reply. In general, homebrew cards cost less than store-bought ones, too.

The cheapest way to roll your own is with paste-ups and postcards. This actually gets you the stock free, because the 4¢ apiece you pay for them is only postage. Get some paste, oak tag or white cardboard, scissors, a typewriter, some typing paper and a few hundred postcards. About that typewriter, beg or borrow the best you can find. If a friend works in an office with an IBM Executive or other plush electric, ask her to peck out a few words for you on lunch break. Try for the smallest, plainest type you can get. But you type out your name, exact QTH and all fill-in data exactly as you want it to appear on the card first. Use a ruler to mark off on the oak tag or white cardboard the exact dimensions of a postcard. Then draw in very light blue (which won't reproduce) or VERY light black (erase before printing) pencil a border about ⅛ inch inside the postcard dimensions. Your working area is inside the border. Type on paper your fill-in data, name and QTH. Look around in magazines for a small cartoon illustration that would be amusing and to the point of a QSL. Cut out the fill-in data and the cartoon. Now the callsign . . . you can stencil it in heavy black pencil or india ink, you can cut it out, letter by letter (all same size and style) from magazine type, or for a little money your printer will set it in your chosen size and style.

Position the cut-outs on the oak tag as you want them to appear. Make sure spacing is even and everything is level. When you're ready, paste each item to the oak tag.

To decide how many postcards to buy, remember that the printer has to take time and expense in preparing the negative, plate and press. The more cards you make the smaller your printing cost per card. However, if you're a Novice you may prefer to print comparatively few. If I were a Novice on CW I'd print about 200 cards. An active General on the DX bands might go 500 or more. Make sure you've included everything . . . name, QTH, other station's callsign, band, date & time, RST, Pse QSL Tnx, Rcvr, Xmtr, Ant, IoAR, ARRL, etc., then cart paste-ups and postcards down to the printer.





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If you live in a scenic area or tourist magnet, buy an attractive picture postcard (designed to be viewed horizontally) with at least an inch on top you can cover with your callsign. Look for the maker's name and address in small type on the back. Write to him, asking cost for so many hundred cards. When you get them, send them off to a reputable QSL printer for typesetting your callsign, name & QTH, and overside fill-in data. The professional color photo on the card would look peculiar with a homebrew typeset job.

Perhaps you or a friend has some drawing talent. Have him do up a cartoon of you at the rig. Or perhaps a humorous map, "How the U.S. looks to a Texan," showing Texas larger than Alaska and most of the East Coast. This sort of thing is effectively done gently and from the viewpoint of your own state. Any pleasant cartoon to the point of a QSL is okay.

Fill-in data, if you type your own, will vary with the operator. If you'll keep your rig as long as you expect the cards to hold out, type it in; it'll save writing. If you're a contester or DX'er be sure to duplicate fill-ins for band and mode so you can verify "two-way SSB" QSO's. Reports of CW men should use RST, SSB men use QSA, and AM'ers just RS. If you're multi-mode, use Report. Women can use PRETTY PSE QSL TNX, crossing out what doesn't apply. Religious hams can close with "73 & 76" (God bless you). You can also print in "73 76 88" and check the appropriate one.

The card may be decked out in a variety of ways. I clipped an IoAR insignia from an issue of 73. You'll find the ARRL emblem in QST, your college insignia in the catalog, your state insignia from a Chamber of Commerce. Other symbols can be typed in as a group: RACES, AREC, RCC, DXCC, ROWH, OOTC or what have you.

If you are a photography buff you may be able to get in a photograph of your house, station or even yourself. The trick is to use extremely high contrast techniques all along the line. Try contrast-process (orthochromatic) film, developed in Hunt's Graph-O-Lith developer per instructions. Print on No. 6 paper if you can get it. The reason is that this simple offset process doesn't allow for any tonal range whatever. No grays; black or white. To offset print gray tones you'd have to velox the picture using a special expensive screen which makes a photo composed of maybe 100,000 tiny dots. Money.

There are a few cautions. If you try printing negative, with while letters on black background, do it only with your callsign. If you try printing typewriter-sized letters negative the large amount of ink will block up, forming poorly shaped letters. I'd say minimum type size for negative work is about 24 point (¼ inch high).

Stay away from newspapers for copy, type or even cartoons. Reproduction quality is marginal and the paper tears easily while you're working on it. But if you really want a newspaper cartoon, use it. There are no other hidden obstacles.

Try to stick to one side printed, one color. Each extra color or side printed usually calls for an extra paste-up, negative, plate and print run. For example: for a red-and-blue card mount the material to be printed blue on one paste-up. The printer will make a plate and run the cards through the press using blue ink. Then put the material to be printed red on a different paste-up (not the back of the first one), and the printer will make a second plate and run the cards thru the press a second time. Don't try to overlap for a third color unless the printer is using transparent inks and says it's okay. Printing on the overside of the card similarly calls for a separate paste-up, plate and print run. You pay the bill.

Use offset printing. There are many printing techniques, most of them too expensive. Roto-gravure is beautiful, but I'd spend the same money on a new receiver. A QSL isn't supposed to look like a wedding invitation anyway. Only spirit or mimeo is cheaper than offset.

Shop for a printer as vigorously as for a used receiver. Prices vary. Decide what kind of stock you want (post-cards, picture-post-cards, post-card blanks, white or colored, mat or coated, etc.), whether you want the printer to set your call and QTH in type, how many print runs and cards you'll want, and bargain!

Homebrewing a QSL is as interesting as rolling your own rig, and your custom card will tarry in homes around the world as an honored guest.

. . . WA2ZKR

Jim Fisk WA6BSO
1560 Glencrest Ct.
San Jose, California 95118

The 88¢ Varactor

Use inexpensive diodes for frequency multiplying, limiting, protecting, switching, and tuning

Up until recently the variable reactance diode or varactor has been used principally by amateurs in parametric amplifiers. Because of their relatively high cost, hams have done very little experimentation with this versatile semiconductor device. Consequently, there are several worthwhile applications which remain relatively unknown. With the advent of the 88¢ varactor, a few of these uses should be considered. Although the 88¢ varactors used by the author were purchased at a Lafayette Associate Store, it is reasonable to assume that other outlets will have similar bargains as time goes on and some readily available ones are listed later.

Basically, the varactor is a microwave varicap characterized by a small voltage controlled capacitance and is essentially nothing more than a specially manufactured silicon diode. In fact, for many applications requiring varactors, ordinary silicon diodes behave rather well. However, at higher frequencies, a diode designed specifically for varactor service has fewer parasitic elements than the garden variety silicon rectifier and provides better results.

When the anode and the cathode of a diode

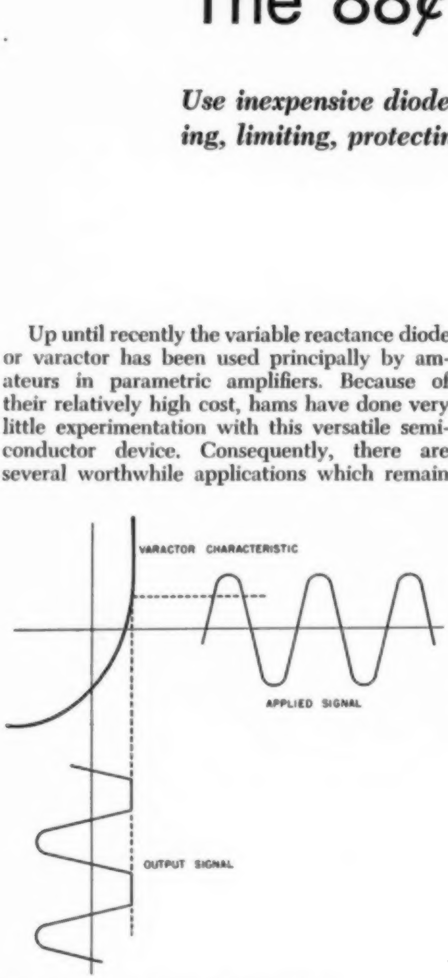

Fig. 1. Varactor harmonic generation.

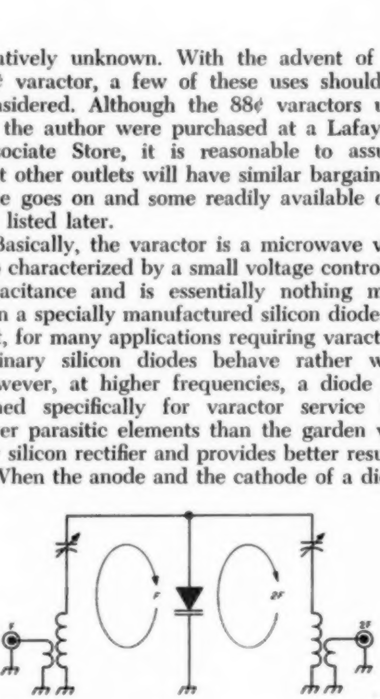

Fig. 2. Varactor doubler.

are diffused during the original manufacturing process, electrons from the cathode cross over the junction to the anode side. This exchange of electrons creates an electrostatic field across the junction with the positive charges residing in the cathode and the negative charges in the anode. If an external bias is applied to the diode such that the cathode is more positive than the anode (reverse bias), it tends to draw electrons away from the junction into the cathode region. Simultaneously, the bias potential tends to push electrons toward the junction from the anode and increases the electrostatic charge across the junction by increasing the number of negatively and positively charged silicon atoms nearby. This action is quite similar to that which occurs when a capacitor is charged, and by virtue of this mechanism, it can be seen that the diode junction acts like a capacitor. If the bias voltage is increased, the total number of ionized atoms increases, thereby increasing junction capacity; therefore, the junction exhibits a voltage variable capacitance. It is this property which is useful in harmonic generators, limiters, rf switches, attenuators, modulators, circuit tuners, and of course, parametric amplifiers.

The 88¢ varactor.

Frequency multipliers

One of the most important roles of the varactor is an efficient frequency multiplier or harmonic generator. **Fig. 1** shows how the nonlinear junction capacity results in harmonic generation with these devices. When the junction capacitance of the diode is "pumped" with an incoming signal, the resultant output voltage is badly clipped and rich in harmonics. The varactor should be operated in its most nonlinear range to obtain optimum results as a harmonic generator; in this way the harmonic content of the output voltage is maximized. In most cases the optimum bias point must be determined experimentally, but in any case, some type of bias must be provided to the diode. Either fixed or automatic bias may be used for this purpose, but automatic biasing is the most convenient. This is because the leads associated with an external bias battery are susceptible to noise pickup and can be quite troublesome. Also, fixed bias must be manually adjusted. In high power varactor multipliers the use of automatic bias is necessary to prevent damage to the varactor in case of overloads.

The most interesting feature of varactor harmonic generators is the high efficiency obtainable in doubling, tripling and quadrupling. It is not unusual to obtain efficiencies of 50 to 90 per cent in single stage multipliers. In theory, frequency doubling may be obtained in either a shunt or series circuit arrangement as shown in **Fig. 3.** In the series circuit, the input and output tanks are tuned to the input and output frequency respectively and exhibit high impedances at these frequencies. At all other frequencies they constitute short circuits. In the shunt arrangement, the tank circuits are designed to present short-circuits to the input and output signals; at all other frequencies they represent an infinitely high impedance.

The essential differences between these two circuits is that in the series arrangement, rf currents of the first, second and all higher har-

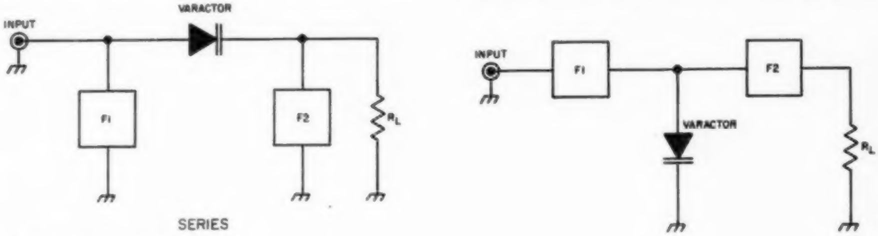

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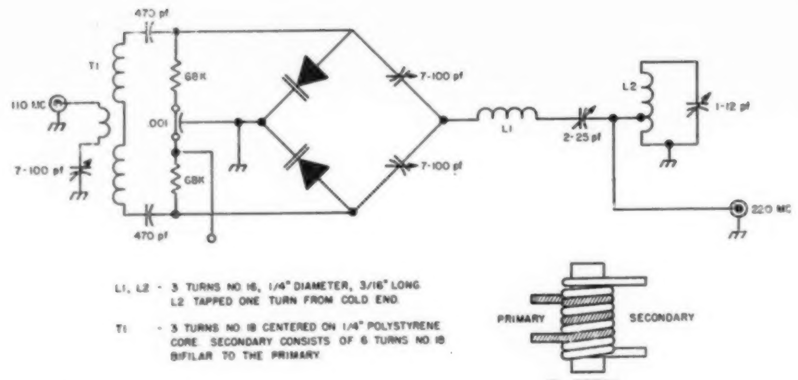
Fig. 3. Varactor doubler circuits.



L1, L2 - 3 TURNS NO 16, 1/4" DIAMETER, 3/16" LONG
L2 TAPPED ONE TURN FROM COLD END

T1 - 3 TURNS NO 18 CENTERED ON 1/4" POLYSTYRENE
CORE SECONDARY CONSISTS OF 6 TURNS NO 18
BIFILAR TO THE PRIMARY

Fig. 4. Balanced varactor doubler.

monics flow through the varactor. In the shunt arrangement the tank circuits allow only the desired rf currents at the input and output frequencies to flow through the diode. This means that in the shunt circuit it is considerably easier to separate the desired and undesired frequencies because the undesired harmonics are inherently attenuated by the resonant tanks. In addition, losses encountered in the varactor are higher in the series circuit. For these reasons, the shunt multiplying circuit is the most desirable configuration. An added advantage of the shunt circuit is that the cathode of the diode is grounded; this makes physical heat sinking of the device more convenient.

An interesting variation to the single-ended varactor doubler circuit is the balanced circuit shown in **Fig. 4.** This particular configuration has several definite advantages over the single-ended doubler because it can handle twice as much power with the same type diode. In addition, the driving energy is automatically cancelled out when the bridge is balanced, thereby simplifying any filtering requirements. In this circuit the trimmer capacitors eliminate the need for matching the diode. About 70% efficiency may be obtained with spurious responses being approximately 40 db below the output signal. With this circuit it is absolutely imperative that the physical component layout preserves electrical balance.

For higher orders of multiplication the simple doubler circuits are inefficient and must be modified by the addition of a so-called "idler" circuit. In the tripler circuits depicted in **Fig. 5,** the idler circuit is represented by "F2", indicating that it is tuned to the second harmonic of the fundamental. Both series and shunt type tripler circuits are illustrated, but the advantages of the shunt arrangement as noted under frequency doublers apply equally well to higher order multipliers.

In **Fig. 5** the blocks designated by F1, F2 and F3 represent filters with zero impedance at the first, second, and third harmonics respectively; at all other frequencies they exhibit essentially infinite impedance. The operation of this circuit may be explained as follows: when the driving signal is applied to the input of the multiplier, the fundamental rf current flows only through F1 and the diode; it cannot flow through either F2 or F3 because they present infinitely high impedances at the fun-

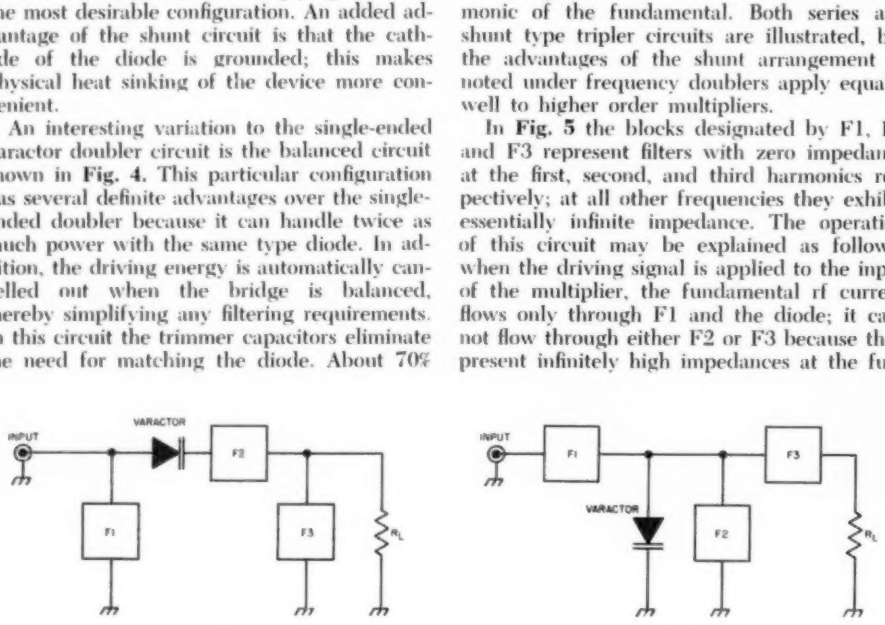


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Fig. 5. Varactor tripler circuits.

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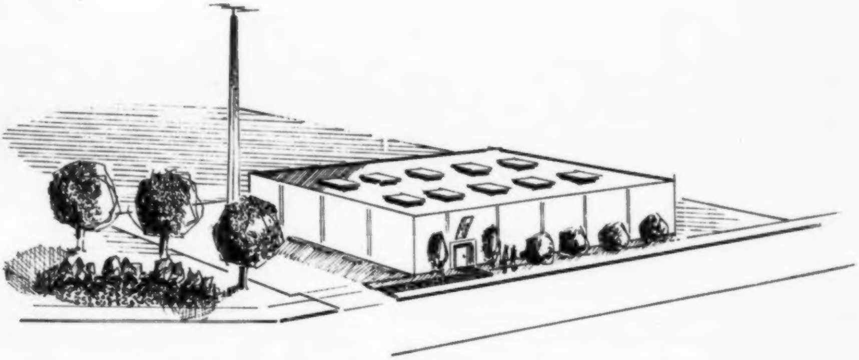

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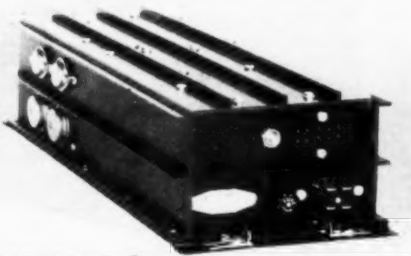

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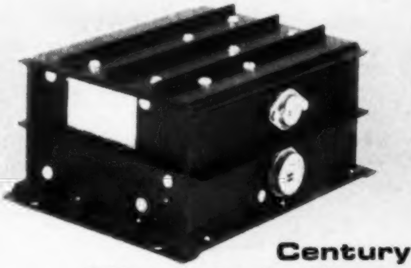

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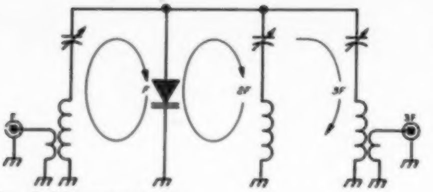


Fig. 6. Varactor tripler.

damental frequency. Because of the nonlinear characteristic of the varactor, second harmonic energy is developed across the diode. This second harmonic current circulates only through the diode and F2, because at this frequency F1 and F3 constitute high impedance. The fundamental and second harmonic currents circulate simultaneously through the diode, which operates as a mixer and produces energy at the third harmonic (i.e., F1 + F2 = F3). The third harmonic current flows through F3, the diode and the load (R_L), but not through F1 or F2 which again offer an infinitely high impedance.

A similar explanation may be given for the operation of a frequency quadrupler; the only difference between the circuits is that the output tank in the quadrupler is tuned to the fourth harmonic instead of the third. In the tripler circuit the varactor operates once as a doubler and once as a mixer; in the quadrupler it doubles twice. However, even with careful tuning, a quadrupler will have considerably more loss (and less output) than two cascaded doublers.

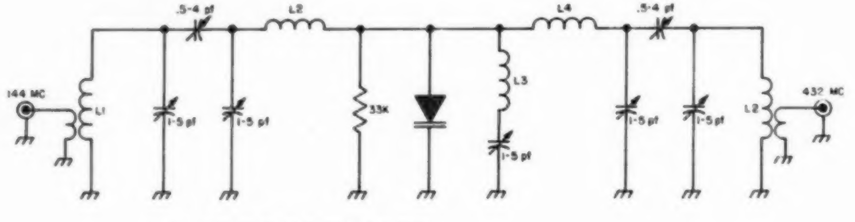
Theoretically, a varactor may be used for even higher orders of multiplication, but the number of idler circuits must be increased accordingly. Unfortunately, these additional tuned circuits seriously limit the bandwidth of the multiplier stage. This becomes important because as the varactor is excited by the fundamental signal, the associated capacitance change will slightly vary the resonant frequency of each of the tuned circuits. In cases where bandwidth is relatively narrow, the circuit will be detuned to the point where efficiency is seriously effected.

Limiters

The varactor limiter provides a simple method for protecting receiver input circuitry at VHF without degrading low-level signals. In strong signal areas some type of protection is required, particularly where transistor rf amplifier stages are involved. The beauty of the varactor is that it may be placed at any convenient point in the circuit with a minimum effect on circuit operation, except for signal limiting. In addition, these devices are inherently self-limiting and require no external bias to achieve limiting action.

A good high quality varactor diode exhibits a typical zero bias capacitance of about one picofarad; less than normal wiring capacity. When the input signal is less than one milliwatt, the varactor capacity is not effected, but as the input power is increased to 10 milliwatts or more, sufficient voltage is developed across the diode to increase its effective capacity. Under this condition the shunt capacity across the circuit increases the insertion loss by several tenths of a db. As the input power is further increased, varactor capacity increases, and at about the 50 milliwatt level the capacity is sufficient to shunt nearly all of the incoming signal to the ground. As the input power is increased beyond this point, the diode becomes essentially a short-circuit across the protected stage. The limiting properties of a typical diode of this type are plotted in the graph of **Fig. 8.**

There are two basic configurations of varactor limiters; the single diode limiter in **Fig. 9** and the two diode shunt-opposed limiter in **Fig. 10.** The action of the single diode limiter varies under different signal conditions.



L1, L2 - 7 TURNS NO. 20 WOUND ON 1/4" FORM
L3 - 5 TURNS NO. 20 WOUND ON 1/4" FORM
L4, L5 - 3-1/2 TURNS NO. 20 WOUND ON 1/4" FORM

Fig. 7. Practical varactor tripler.

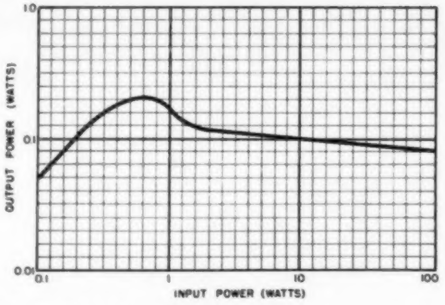


Fig. 8. Typical varactor limiting.

but the "worst case" is illustrated by the accompanying waveform shown in **Fig. 9.** A rather rigorous mathematical analysis shows that just the right phase relationship must exist for the voltage spike to occur, but even though this unfavorable phase will occur only about half the time, in many cases the spike is sufficient to burn out transistor rf stages. The fact that the voltage is **sometimes** absent offers little comfort.

The size of the spike decreases with frequency and might be tolerable when the incoming signal is not too large, but a complete analysis of the operating conditions requires some rather healthy math and the possibility of voltage spikes certainly encourages the use of the shunt-opposed limiter of **Fig. 10.**

In the shunt-opposed circuit, the first cycle begins in a manner similar to the single diode configuration, but regardless of the phase of the incoming signal, the second varactor begins to charge and limits the negative voltage excursion where the spike previously occured. The second diode will carry the current, first charging and then discharging, until the average net charge across the circuit is zero. It does not however, immediately settle down to a nice, even, periodic waveform. Although each succeeding cycle comes closer and closer to being the same, theoretically it takes an infinite number of cycles before they are precisely identical. However, for all practical purposes, they can be assumed to be the same after ten or eleven complete cycles.

The isolation of the shunt opposed pair can be improved by the use of forward bias, but there is the chance that this bias will favor the uneven disposition of rf current between the varactors. In this case the diode first charged in the forward direction will tend to carry all of the incoming signal current.

A typical application of the limiter is where the varactor is connected in shunt across the tank circuit of a transistorized rf amplifier as illustrated in **Fig. 11.** One advantage of this application is that the diode may be added to existing circuitry with a minimum of circuit retuning. This same approach is equally applicable to vacuum tube circuitry (**Fig. 12**) or, if desired, the varactor limiter may be inserted directly across the transmission line to the receiver.

Switches

The operation of the varactor diode as an rf switch is somewhat similar to that of the limiter. As a switch however, the required capacitance change is controlled by an external bias source. In normal operation, this application more nearly parallels the operation of a vacuum tube TR switch than an antenna changeover relay.

When a varactor is installed in series or in shunt in a transmission line, the rf power transmitted down the line to the diode is either reflected, absorbed, or transmitted past. Although the power in an ideal diode switch would be either entirely reflected or totally

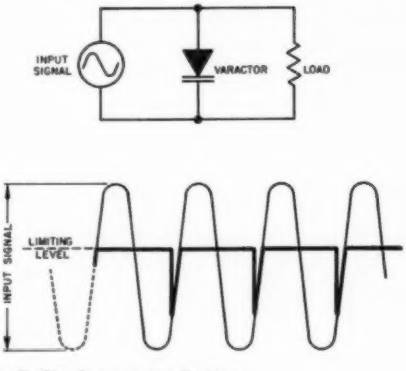


Fig. 9. Single varactor limiter.

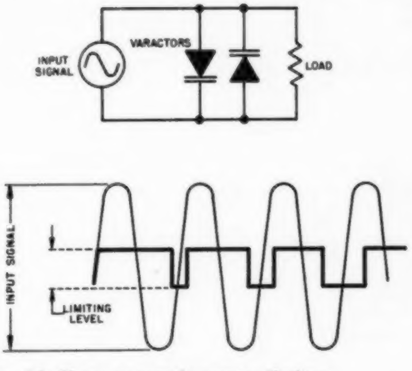


Fig. 10. Shunt-opposed varactor limiter.

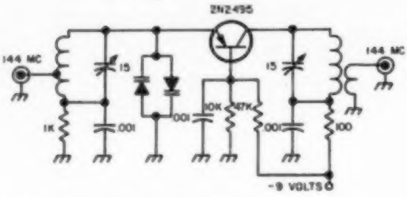


Fig. 11. Varactor protected transistor stage.

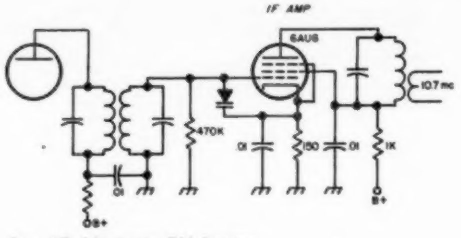


Fig. 12. Varactor FM limiter.

transmitted, a practical switch is not quite this ideal. In most cases more power is reflected than absorbed however, and with typical insertion losses of 0.3 db and isolation of 40 db or more, the diode switch is at least as satisfactory as the common solenoid operated coaxial relay. At frequencies up to about 1000 mc the series switch provides slightly greater isolation than the shunt arrangement when used in 50 ohm coaxial lines.

When a reverse biased diode is installed in series with the center conductor of a coaxial line (**Fig. 13**), the small junction capacity (on the order of 0.5 pf) presents a high impedance in series with the line. At 3.5 mc for example, 0.5 pf represents nearly 100,000 ohms; this appears as an open-circuit to the 50 ohm line and most of the r-f power is reflected. On the other hand, when the diode is forward biased, the junction capacitance increases and results in a negligible impedance in series with the line. The overall effect in the forward-biased condition is an rf impedance that presents a low-loss, near match to the transmission line and allows the rf power to pass.

In the shunt configuration, diode switching is essentially the converse. If a reverse bias is impressed across the diode, the extremely small junction capacity placed across the transmission line results in very little added loss, typically less than 0.5 db. However, if the varactor is forward biased to maximum capacity, the large shunting capacity of the diode effectively shorts the line and reflects the r-f power.

There are several switching schemes in which these characteristics may be used to control the transmission line during receive and transmit cycles. Perhaps the simplest of these is the single diode arrangements shown in **Fig. 14.** This circuit takes two basic forms, depending on whether a shunt or series diode is used. In the shunt arrangement, the varactor is biased to maximum capacity during the transmit cycle. With the line effectively shorted, the transmitter sees an infinite impedance one-quarter wavelength away. In fact, to the transmitter it appears that the line to the receiver doesn't even exist. When receiving, the diode is reverse-biased and signals from the antenna proceed down the line to the receiver undisturbed.

If a series diode is used, the switch is located one-half wavelength away as shown in **Fig. 14B.** During the transmit cycle in this case, the diode is reverse biased and presents a high impedance across the line. This effective "open" line is reflected to the transmitter one-half wavelength away and again it appears that the receiver line does not exist.

The major disadvantage of these simple single diode switches is that they may be used only over a very narrow band of frequencies. This is perfectly satisfactory for spot frequency operation such as occurs on our 432 and 1296 bands, but on the lower frequencies a more broadband device is required. Another disadvantage of this switch is that

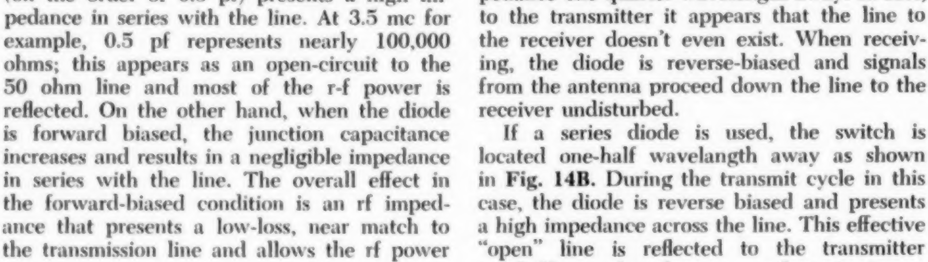


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Fig. 13. Coaxial Varactor rf switches.

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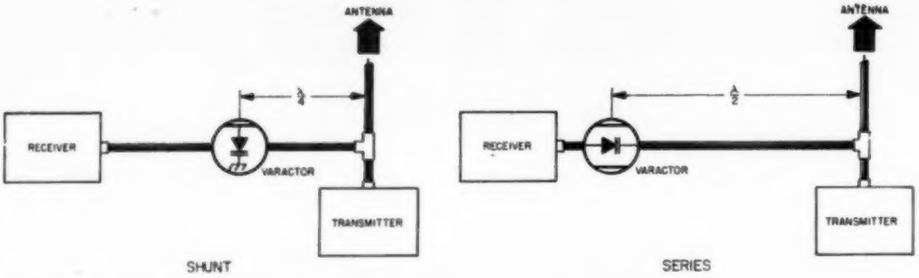

SHUNT

SERIES

Fig. 14. Single varactor transmit-receive switches.

slight losses occur to the received signal because the output tank of the transmitter is not isolated from the line.

The transmission line switch shown in **Fig. 15** overcomes these disadvantages by the simple expedient of adding another diode. This two diode circuit is not at all frequency conscious and may be used over extremely wide bandwidths. In this circuit both the receiver and transmitter portions of the transmission line are diode controlled. When transmitting, diode #1 is forward biased and diode #2 is reverse biased. Under these conditions, the transmitter power is passed by diode #1, but the high impedance presented by diode #2 effectively opens the line to the receiver. In the receive mode, the opposite is true; the transmitter is isolated from the line and the antenna signal passes into the receiver with little loss.

One of the most important considerations in diode switches is the amount of rf power they can safely handle. Actually, there are two separate and distinct ratings that are of interest: peak power and average power. The peak inverse voltage (PIV) rating of the diode determines the maximum peak power that the diode can control. The average power which the diode can safely switch is dictated by its power dissipation and series resistance. Since the series and shunt diode circuits operate in somewhat opposite ways, it would not be unusual to expect that their power ratings might be different. This is indeed the case and it is interesting to note that although the shunt circuit has twice the peak power rating as the series circuit, its average power rating is only one-quarter as much as that of the series arrangement. For 50 ohm coaxial transmission lines operating with an SWR of 1:1, the respective power ratings may be calculated from the following equations:

Series	**Shunt**
Peak Power $= (\text{PIV})^2/1600$	Peak Power $= (\text{PIV})^2/400$
Average Power $= 25\ P_d$	Average Power $= 6.25\ P_d$

Where: PIV = Peak inverse rating of the diode (volts)
P_d = Power dissipation rating of the diode (watts)

From these formulas it can be readily found that to control the peak power of a 1000 watt CW transmitter operating at 70% efficiency (700 watts into the transmission line), a series diode would require a PIV of 1058 volts; under the same conditions a shunt switching diode would require a PIV of 529 volts. For insurance against blowing the diodes under peak power loads or SWR changes, a safety factor of 50% should be added to these figures.

In addition to the strictly off-on capabilities of varactor rf switches, they may also be used as voltage variable attenuators and amplitude modulators. As voltage variable attenuators they operate somewhat differently than normal attenuators in that they are not absorptive. Whereas most attenuators consist of resistance networks which provide attenuation by absorbing rf power and dissipating it in heat, the diode attenuator operates on the reflective principle in exactly the same way as the diode switch, with attenuation being directly proportional to the amount of bias across the diode. The direction of bias of course is determined by the circuit configuration, series or shunt.

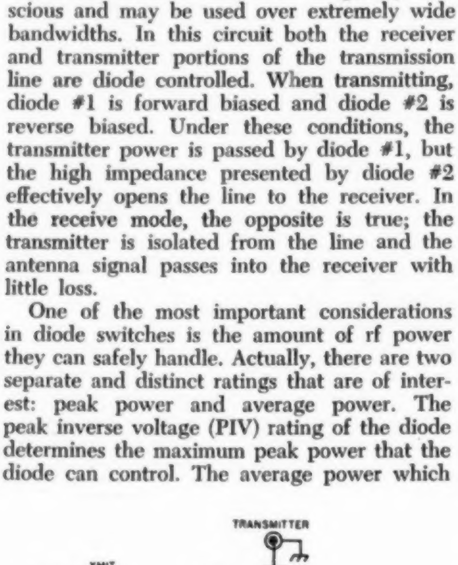

Fig. 15. Two varactor transmit-receive switch.

Varactor amplitude modulators are just an extension of the attenuation principle. In the attenuator, the bias consists of an adjustable source of dc voltage. In a modulator, the diode bias is modulated by the audio output of a microphone amplifier. As the bias is varied at the audio frequency, the attenuation of the diode circuit varies in exactly the same way. Therefore, the magnitude of rf power passing through the attenuator is directly proportional to the modulating audio voltage and we have an amplitude modulated wave. These applications are particularly well suited for the upper UHF and microwave frequencies where attenuators and amplitude modulators are difficult to build with normal run of the mill components.

Circuit tuning

Since varactor capacitance varies from very small values when reverse biased to very large values when forward biased, these diodes may be used to electronically tune rf amplifiers, local oscillators, filters and preselectors. The only limitation is that the circuit which the varactor tunes must be small-signal oriented; that is, the signal must be small compared to the bias across the varactor. This becomes obvious when we consider that if the circulating r-f energy is more than about 10 milliwatts, the varactor will start to act like a limiter.

The simplest method of tuning is to place the varactor in parallel with an inductor as illustrated in **Fig. 16A.** Here the varactor provides the total capacitance of the tuned circuit, but circuit Q will be quite low. Theoretically this arrangement is tunable from zero to the maximum frequency dictated by the minimum capacity of the diode, but circuit losses are high because of the low Q.

For amateur applications where tuning a complete band normally represents only 10% or less of the center frequency, a better arrangement is shown in **Fig. 16B.** Here the diode is in series with the capacitor C_1 and in parallel with the shunting capacity C_2. In this circuit the Q is increased by a factor of six.

An application of this circuit is the electronically tuned two meter rf amplifier illustrated in **Fig. 17.** With the constants shown and a microwave varactor, this circuit will tune the entire 144 mc band. The frequency is initially adjusted to the desired point with the variable shunt capacity C_2. After this initial adjustment, any tuning is accomplished with the 50 K potentiometer.

Although this circuit is oriented around a small capacity varactor, the same technique may be applied to lower frequency circuits with regular varicap diodes. In this case, the series and shunt capacitors should be chosen so that they are about two-thirds the minimum capacity of the diode.

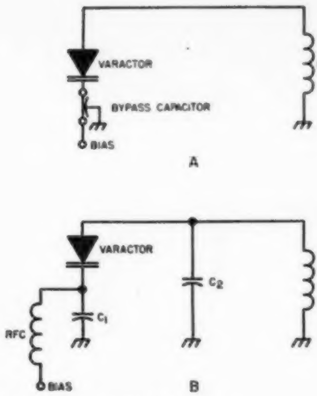

Fig. 16. Varactor tuning circuits.

In addition to normal tuning duties, this type of circuitry has several other important applications. One of these is as frequency modulators of oscillator stages. As a frequency modulator the diode bias is actually modulated by a microphone or other external audio signal. The amount of frequency deviation is regulated by the amount of modulated bias placed across the varactor.

Summary

Although the circuits described in this article are predicated on the use of small capacity microwave varactors, in many cases, particularly at the lower frequencies, other diodes will work equally as well. Two 88¢ varieties that are recommended as starters are the 1N82A and 1N3182.

. . . WA6BSO

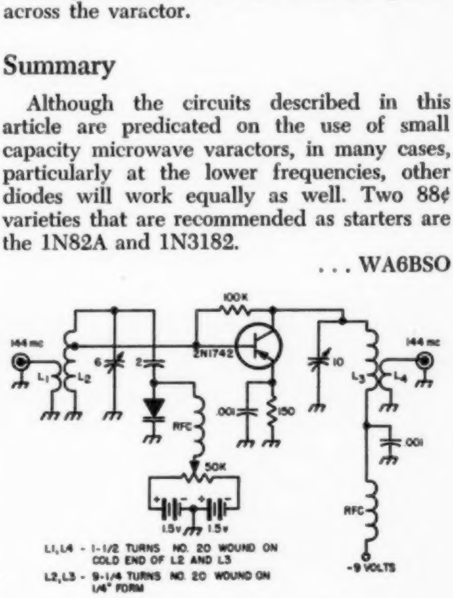
100K
144 mc
2N1742
144 mc
L1
L2
6
2
10
L3
L4
.001
150
RFC
.001
50K
RFC
1.5v
1.5v
L1,L4 - 1-1/2 TURNS NO. 20 WOUND ON COLD END OF L2 AND L3
L2,L3 - 9-1/4 TURNS NO. 20 WOUND ON 1/4" FORM
-9 VOLTS

Fig. 17. Varactor tuned two meter amplifier.

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12 Volt Beetle Juice

For some time now in DL country it has been possible to obtain all Volkswagen models complete with a 12 volt ignition system. The generators on these models are rated at 450 watts. These units are being made to fill the ever-rising commercial demand for a heavier ignition system. Only the VW truck, however, is available in other parts of the world with the heavier, 12 volt ignition.

Those who now own Volkswagens with the 6 volt ignition can either convert the entire system to 12 volts (the 12 volt parts including generator, voltage regulator, starter motor, windshield wipers etc. are also available in Volkswagen garages outside of West Germany) or one can install a second generator rated at 12 volts. The accompanying 12 volt battery can be located behind the back seat, or when a small battery will do (12 volt, 50 ah) it can be installed under the left rear seat.

The generator mounting bracket on the 40 HP motor (since August 1960) can be simply unbolted from the block. This bracket must then be traded for a new one, built to accomodate two generators. (**Fig. 1.**)

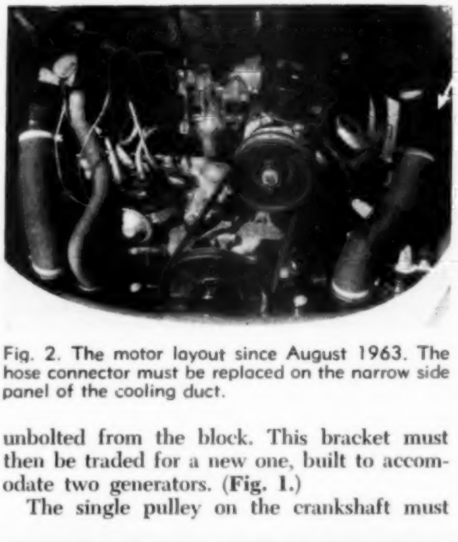

Fig. 2. The motor layout since August 1963. The hose connector must be replaced on the narrow side panel of the cooling duct.

The single pulley on the crankshaft must

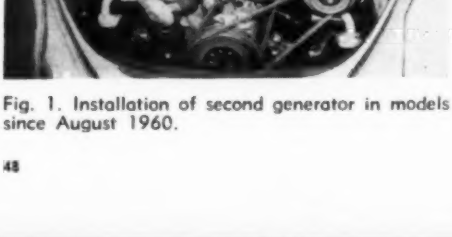

Fig. 1. Installation of second generator in models since August 1960.

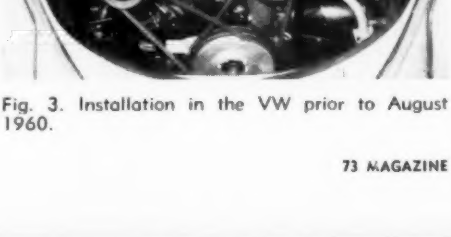

Fig. 3. Installation in the VW prior to August 1960.

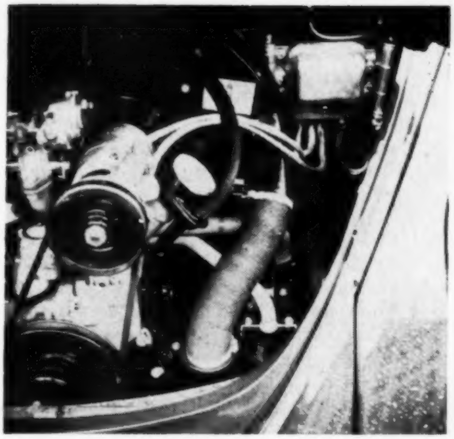

Fig. 4. The 12 volt VW as it comes from the factory.

be removed, and bolted to another of the same size. The voltage regulator for the new 12 volt generator sits to the right, next to the cooling duct on the partition between the motor and passenger compartments.

In 1963, the heating system in the VW was altered. If one wishes to install the double generator mount in this model, the heating hose connector must be relocated to the right on the side wall of the air duct. (**Fig. 2.**) Otherwise, there is no free space for the installation of the second generator. The heating hose must also be lengthened a little.

In the VW Export, previous to 1960, the mounting for the second generator is accomplished with several adjustable arms, and is located above the distributor and fuel pump. (**Fig. 3.**)

The ignition coil must be relocated somewhat higher. Also, the fuel line, from the pump to the carburator, must be bent somewhat differently. The pulley installation is identical to that in the other models. The second voltage regulator now sits to the left of the cooling duct on the forward wall.

In all models, the Bosch LJ/GEG 160/12 2600 R 1 (160 watt) generator with accompanying RS/UA 160/12 voltage regulator, or the 12 volt VW generator is used. If the VW generator is used, the rear shaft must be trimmed off to a suitable length.

The different pulleys are supplied by the Bosch firm. The mounting bracket in **Fig. 1** was fabricated here at the QTH.

These installations have proven to be very satisfactory; and I will gladly be of help in supplying the different parts.

. . . DJ2UL

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A220-11	1¼ meter	11 element	11.95
A430-11	¾ meter	11 element	9.75
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A50-ZP	6 meter	Portable	10.95
A26-ZP	6 & 2 meter	Portable	15.95
A50-3	6 meter	3 element	14.95
A50-5	6 meter	5 element	21.50
A50-6	6 meter	6 element	32.50
A50-10	6 meter	10 element	49.50
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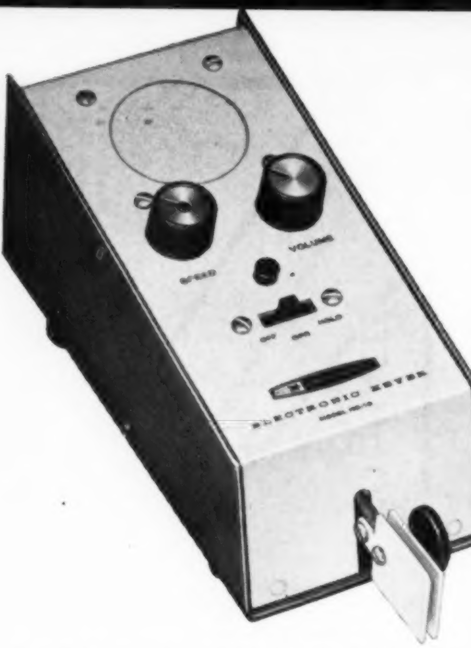

The HD-10

Heathkit's new electronic keyer

Mort Waters W2JDL
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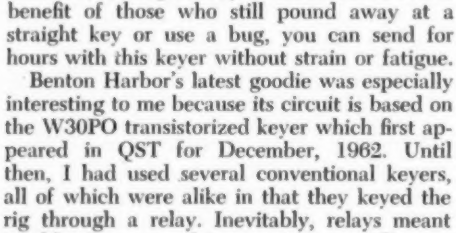
Massapequa, L.I., N.Y.

Recognizing CW's popularity—it's far from dead, despite the claims of the ssb boys—Heathkit has produced an electronic keyer kit that will gladden the heart and tickle the ears of every CW man. Yes, you too can send beautiful, effortless, perfectly formed code. For the benefit of those who still pound away at a straight key or use a bug, you can send for hours with this keyer without strain or fatigue.

Benton Harbor's latest goodie was especially interesting to me because its circuit is based on the W30PO transistorized keyer which first appeared in QST for December, 1962. Until then, I had used several conventional keyers, all of which were alike in that they keyed the rig through a relay. Inevitably, relays meant trouble. Sooner or later, contacts got dirty or needed readjusting. The W30PO job boasted of one feature that sold me—instead of a relay, a switching transistor was the keying medium. No moving parts. Nothing to foul up. Hallelujah! It has worked like a charm ever since.



The HD-10 kit utilizes the printed circuit board shown here. Almost 90 parts mount on it—including the power transformer at right, rear.

Heath's designers improved that circuit, added a few ingenious touches of their own, squeezed in a paddle and packaged the whole thing in a neat little box only 3¾x4¼x10½ inches, painted in the now traditional colors—two-tone (Wayne?) green, same as the SB100, 110, 200, 300, 400 . . . and who knows what's to come? There's still a lot of numbers left.

It was a pleasure to assemble this kit. Although the number of parts is surprisingly large (there are 49 resistors, 18 capacitors, 6 diodes, 11 transistors and 2 transformers), a single circuit board takes care of everything except a few odds and ends, such as speed and monitor volume controls, pilot light, etc.

As I've come to expect from Heath, the instruction manual is a model of clarity. Success is assured by following the instructions and soldering properly. And, speaking of soldering, Heath now includes in their kits a new full-color booklet that is a complete course in soldering and kit-building.

Now, to the kit! There's no point in covering the assembly details here; that's the function of the manual. I'd suggest only one thing that the manual doesn't mention. The screws which fasten an eight lug terminal strip to the rear panel are also used as binding posts for ground connections. Before attaching the strip, sand the paint from the inside face of the back panel, to assure a good ground. Do the same where the phone jack mounts.

The built-in paddle is simple and ingenious and more than adequate for keyer beginners. (See photos for details of its construction). Once you've become skillful, you'll probably want to switch to a paddle that has more precise action and is easily adjusted. Thinking ahead, Heath has provided for attaching an external paddle to the rear panel.

By changing jumpers and connections on the rear panel you can have any mode of operation you can think up, plus a few you never suspected. Here's what the keyer can do:

1) Choice of built-in or separate external paddle

2) Conventional operation; automatic dots and dashes

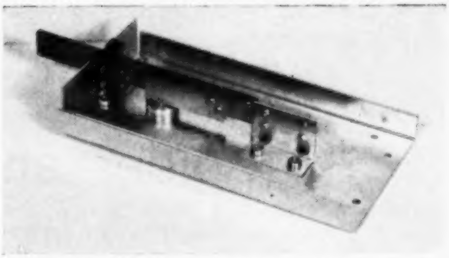
3) Automatic dots and manual dashes

4) Hand key or bug can be attached externally.

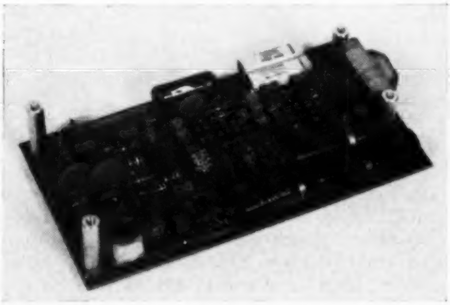
Flexibility extends to monitoring also. The built-in sidetone generator can be heard through its self-contained speaker or through earphones plugged into the rear panel jack. For deluxe on-the-air monitoring, feed the receiver audio to the keyer. When the station is in "receive" condition, you hear the receiver through the phones plugged into the keyer. Switch to "transmit" and the sidetone is heard through the same phones when you key.

The kit took only 4½ hours to assemble, including the time I spent taking photographs, so you can see it isn't a major project. It worked fine first try, but one diode opened about ten minutes later. Once replaced, however, no further trouble was encountered.

The dot-space ratio is adjusted in seconds with the help of a VTVM or a 'scope and the circuitry assures that dashes will be exactly three times as long as dots. The adjustments hold throughout the full speed range. You have your choice here too—two pairs of resistors are furnished; one gives 10 to 20 wpm, the other 15 to 60 wpm. You wire in the pair for the range you want.



Paddle subassembly complete except for handle. Strips of spring brass provide adjustable tension and the small snap switches used for contacts may be adjusted for desirable spacing.



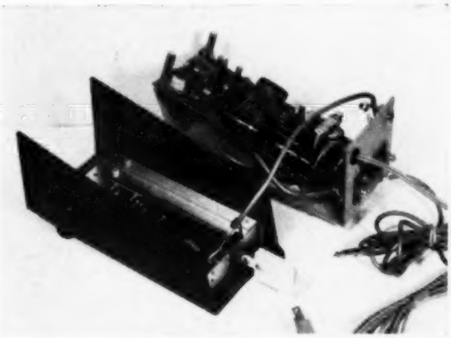
Completed board with all parts soldered and four metal spaces in place. The spacers support the board upside down in the case.

The Heathkit HD-10 keyer can handle any transmitter using grid block or other types of keying where a negative voltage is shorted to ground to key the transmitter. The keying transistor, a 2N398A, is rated to handle a maximum of −105 volts at 35 ma. Make sure the current and voltage at your key terminals are within these limits. Slightly higher ratings can be had by substituting a type 2N398B, about $1.45 at most parts jobbers.

In most installations the built-in 110 volt ac power supply will be adequate. For portable or emergency use, however, two 22½ v. batteries in series, or one 45 v. source tapped at 22½ v. will do the trick. Overseas hams can adapt the ac power supply to 230 v. by inserting a .068 µf 600 wvdc capacitor in series with one leg of the line cord.

As good as my W3OPO keyer was, this one is even better. One of my buddies—an old, old timer—instantly recognized the improvement without knowing I was using a new keyer.

. . . W2JDL



Ready for final assembly with all parts completed. Circuit board mounts upside down over paddle. Metal cover with control panel follows last.

Joseph Crowling K4CPR
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Warrenton, Virginia

Solder and Soldering

Soldering is one of the oldest and simplest methods of joining electronic components. Because of its simplicity and ease of application, it is often used, but seldom studied or analyzed. Have you ever studied solder or the art of soldering? The subject is very important and deserves a little more attention than most amateurs give it. Murphy's law (If anything can go wrong, it will,) applies to soldering. If taken for granted, soldering can cause trouble.

Alloys

Soft solder, consisting mainly of tin and lead, is used for most electronic assembly. Soft solders make connections by virtue of a metal solvent action that takes place at low temperatures. The solvent action makes solder joints chemical in character rather than purely physical.

Fig. 1 shows a tin-lead fusion diagram. From this diagram, it is evident that the addition of tin to pure lead lowers the melting point of the alloy until an alloy of 63% tin–37% lead is reached. This alloy has the lowest melting point (361° F) and is known as the eutectic alloy. The eutectic alloy does not pass through a plastic state before it becomes molten. If more than 63% tin is added, the melting point temperature will begin to rise again.

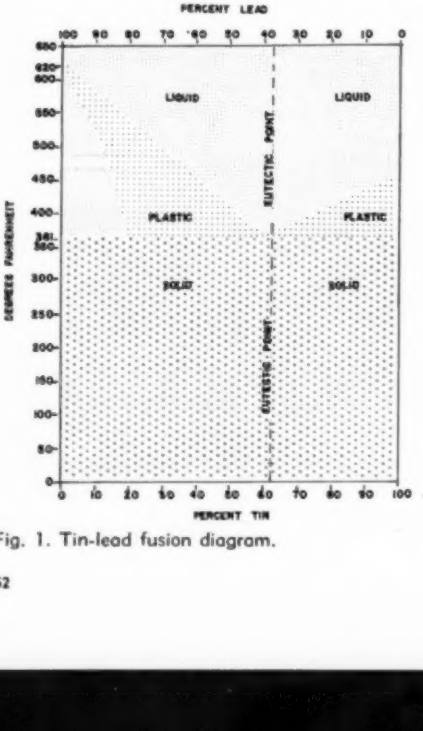

Fig. 1. Tin-lead fusion diagram.

Commercially available solders cover the entire range of tin-lead ratios from pure tin to pure lead. What is the best alloy for electronic asembly purposes? To answer this question, it should be remembered that the primary purpose of solder is to connect two or more metals, but resistance to stress and strain, speed of alloy formation, flow and spread of the solder, and chemical stability of the joint, must also be considered. There is no one alloy that is the answer to all problems but for electronic assembly there is a fairly large range of alloys that give good results; the exact choice is up to the individual. Alloys from 50% tin–50% lead to 60% tin–40% lead will give good results for most amateur needs. It is interesting to note that the best physical properties (stress and strain resistance) occur with an alloy of approximately 60% tin, and the lowest melting point occurs with 63% tin, but from a practical standpoint, any alloy with 50% to 60% tin will give good results.

Flux

All metals are covered with an oxide film. This film is nonmetallic and will prevent the metal solvent action (soldering) from taking place. Flux is added to the solder in order to remove the oxide film and allow the clean metal surfaces to make contact. The flux will remove only the oxides. It will not remove paint, dirt, or other foreign matter. The choice of proper flux is one of the most important steps in obtaining good solder joints. There are hundreds of different fluxes, but for the purpose of discussion, they will be divided into four groups: (a) rosin (b) activated rosin (c) organic (d) acid.

Rosin flux gives good fluxing action. This flux is corrosive only when heated to a molten state. The corrosive action is needed to remove the oxides from the components being soldered. When the heat is removed, the residue that is left is noncorrosive and electrically nonconducting.

Activated rosin fluxes have a more effective fluxing action than pure rosin. They were developed to meet the demand for a faster more efficient soldering process. The residues should be noncorrosive and nonconductive. Be careful when purchasing activated rosins, some of the advertising is misleading.

Organic fluxes are more effective than rosin or activated rosin but they leave corrosive residues. These fluxes are used when the fluxing action of rosins is insufficient and when small amounts of corrosion may be tolerated. The residues should be removed.

Acid fluxes are the most effective but they leave corrosive and electrically conductive residues. The word "acid" is a misnomer since the fluxes are actually salts. The residues absorb moisture from the air and the corrosive action is probably due to galvanic or electrolytic action. These fluxes are used only when their great activity is needed. Kit manufacturers will not guarantee their kits if acid core solder is used.

The choice of a flux can be a complicated problem, but you will not go wrong if you choose the least active flux that will give good results for your particular application. For electronic assembly, pure rosin or some of the activated rosins would be the best choice.

Soldering

After the choice of a proper alloy and flux, good soldering becomes a function of the individual's technique. For good solder joints the following must be observed:

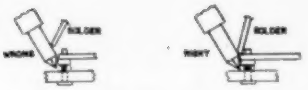

Fig. 2. Application of solder.

1. Use the proper alloy and flux.
2. The soldering iron must of sufficient wattage rating. (Don't try to use a 25-watt pencil iron to make a connection to a ground lug on a large aluminum chassis and don't use a 125-watt gun type iron on a printed circuit board.) The iron should have a bright, smooth, tinned tip for most efficient heat transfer to the joint. Clean the tip periodically.
3. All elements of the joint should be clean. (No dirt, paint, grease or other foreign matter.)
4. Use the iron to heat the joint and apply the solder to the junction of the tip and the joint. (**See Fig. 2.**) Remove the iron when the solder wets the joint. Don't use excessive solder. The joint must not be jarred or subjected to vibration before the solder cools. Such motion will cause cold solder joints.
5. Inspect each joint. A properly made joint has a smooth appearance and a satin-like luster. Wiggling the components of the joint by hand or with pliers will also help make sure the joint is a good one.

Given the proper tools and a little experience, anyone can make good solder joints. Because of the simplicity of soldering, many people take it for granted and never bother to learn the fundamentals. Soldering is simple, but it can cause trouble. The failure of a solder joint is the same as the failure of a component, but it can sometimes be much harder to find. Don't let a few cents of solder ruin the performance of hundreds of dollars of electronic equipment.

. . . K4CPR

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APO 132, N.Y., N.Y.

The Rhombic Antenna

The rhombic antenna has been used as a directive antenna system almost as long as "Wireless" or radio broadcasting. Phil Rand W1DBM, first built and operated a rhombic for amateur communications way back in 1931!

The purpose of this article, therefore, is not to bring you a new antenna development, but rather to acquaint, or re-acquaint you with the construction and operation of this outstanding antenna.

No single antenna array, regardless of its size, shape, or electrical characteristics, is capable of producing the ultimate in gain and/or directivity, when operated over a wide span of frequencies. The rhombic however, probably comes closer than any other antenna to meeting these criteria. **Fig. 1** lists the gain of rhombics of various leg lengths.

Before continuing further let's define just what a rhombic antenna is. A rhombic antenna is a form of long wire antenna, or to be more exact, a combination of long wires, so constructed as to produce maximum gain per unit of length. This long wire type antenna can be considered as two V beam antennas placed end to end, or two obtuse angle V beam antennas placed side by side to form a rhombus, or diamond. (See **Fig. 2**).

leg length (wave lengths)	*db gain*	*leg length (wave lengths)*	*db gain*
2	7.4	7	13
3	9	8	13.5
4	10.5	9	14
5	11.5	10	14.5

Fig. 1. Approximate gain (in decibels) for maximum output rhombics compared to a half wave dipole at the same elevation.

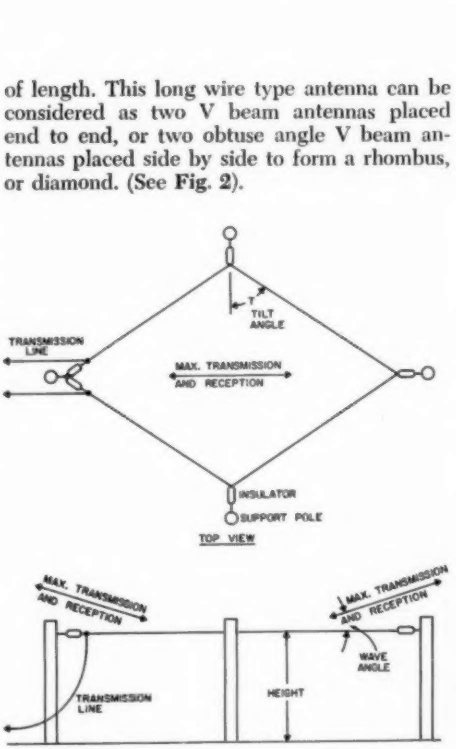

T
TILT ANGLE
TRANSMISSION LINE
MAX. TRANSMISSION AND RECEPTION
INSULATOR
SUPPORT POLE
TOP VIEW
MAX. TRANSMISSION AND RECEPTION
MAX. TRANSMISSION AND RECEPTION
WAVE ANGLE
TRANSMISSION LINE
HEIGHT
SIDE VIEW

Fig. 2. The rhombic antenna.

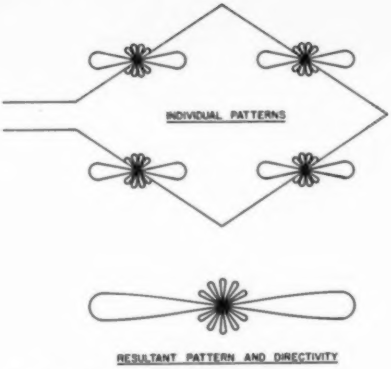


Fig. 3. Bi-directional rhombic.

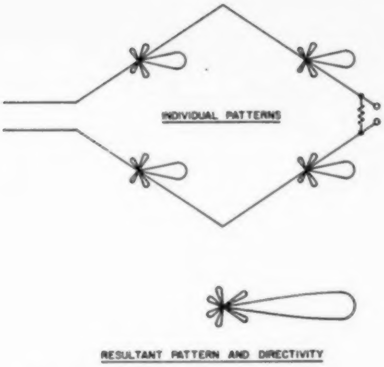


Fig. 4. Uni-directional rhombic.

The rhombic antenna is usually oriented in the horizontal plane, and in its basic form, produces a horizontally polarized bi-directional pattern, with maximum radiation occurring at some vertical angle above the plane of the antenna. This angle of radiation, or lobe, is called the wave angle, and is shown by the Greek letter delta (Δ). The *tilt* angle, or *T*, is one half angle between the two legs making up one side of the antenna.

Fig. 3 shows the rhombic with a bi-directional pattern. This bi-directional pattern results because a part of the energy traveling from the input, or feeder end of the antenna, toward the far end of the antenna, is reflected back, producing standing waves on the antenna legs. Because of these standing waves, this type is known as a resonant rhombic.

In order to make a rhombic uni-directional, it must be terminated with a non-inductive resistance of the proper value. The function of this terminating resistance is to absorb any energy that might be reflected back toward the feeder, or input end of the antenna. The terminated rhombic, therefore, is non-resonant. Termination of the rhombic, in addition to making it uni-directional, provides a feed, or input impedance which is constant over a wide range of frequencies. (See **Fig. 4**)

We will get back to the fine points of termination, and other aspects of design and layout of the rhombic, but right now, let's take up the advantages of this antenna array.

Some of the advantages of this antenna are as follows:

a. Produces excellent results over a frequency range of 4 to 1 (80–40–20–15 meters, for example).

b. Is easier to erect and maintain than other antennas of comparable gain and directivity.

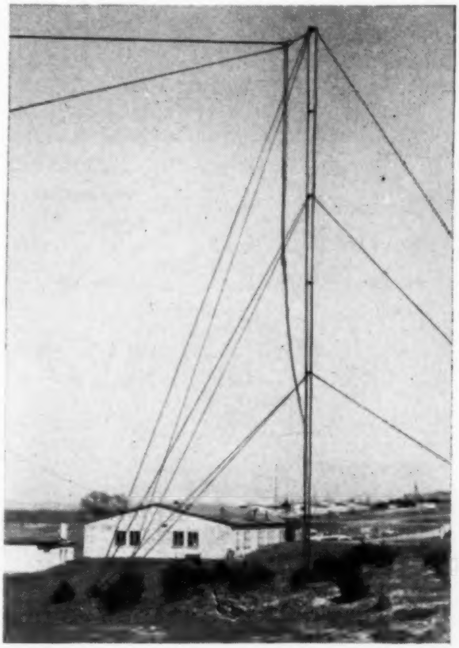
c. Is non-critical in operation and adjustment (broad tuning).

d. Can be made uni-directional by use of a terminating resistance.

On the disadvantage side, these are some of the factors to consider:

a. A large space is required for erection.

b. When terminated with a resistance, approximately 35 to 45% of the power fed to the antenna is dissipated in the termination resistance.



Rear pole with ¼ wavelength stub and coax balun for DL5UW's 20 meter rhombic.

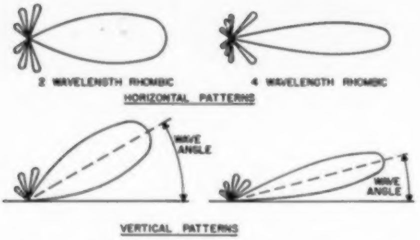


Fig. 5. Vertical and horizontal patterns of rhombics.

c. The horizontal and vertical patterns are interdependent, thus, for example, a rhombic designed to produce a narrow horizontal beam will have a fairly sharp and low vertical pattern. (See **Fig. 5**).

There are two main types of design for a rhombic antenna. One is known as the maximum output design, and the other as the alignment design. As the name implies, the maximum output design rhombic produces maximum gain if certain design parameters are adhered to. If, for example, we desire to cover a 4000 mile path, with a two-hop skip, we might choose a vertical wave angle of 15 degrees and design the antenna around this figure. In order to have the antenna produce maximum power at this vertical wave angle of 15 degrees, we must use certain valves of leg length, tilt angle, and height above ground. Any variation from these valves, will reduce the gain at the desired wave angle.

These computations for a maximum output rhombic, with a 15 degree wave angle are as follows:

$$\text{H (Height in wave lengths)} = \frac{1}{4\sin\Delta}$$

$$\sin\Delta = .25882$$

$$4\sin\Delta = 1.03528$$

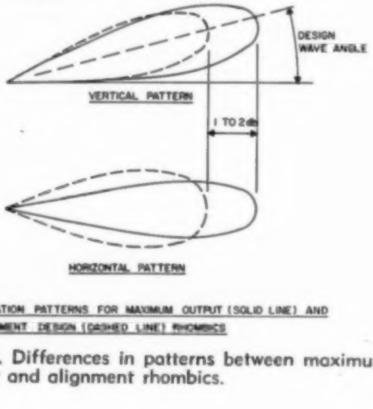

DESIGN WAVE ANGLE
VERTICAL PATTERN
1 TO 2db
HORIZONTAL PATTERN
RADIATION PATTERNS FOR MAXIMUM OUTPUT (SOLID LINE) AND ALIGNMENT DESIGN (DASHED LINE) RHOMBICS

Fig. 6. Differences in patterns between maximum output and alignment rhombics.

$$H = \frac{1}{1.03528}$$

$$H = .97$$

$$\text{L, leg length} = \frac{1}{2\sin^2\Delta}$$

$$\sin\Delta = .25882$$

$$\sin^2\Delta = .066466$$

$$2\sin^2\Delta = .13398$$

$$L = \frac{1}{.13398}$$

$$L = 7.4649$$

$$\text{Tilt Angle, or } \phi \text{ (PHI)} = 90^\circ - \Delta$$

$$\phi = 90^\circ - 15^\circ$$

$$\phi = 75^\circ$$

When a sufficiently large antenna site is not available for a maximum output rhombic, the leg length can be made about 74 precent of the maximum output leg length, or by

$$\text{formula L, or leg length} = \frac{.371}{\sin^2\Delta}$$

This shortened leg rhombic is known as the alignment design rhombic. The height, and the tilt angle are the same for any given wave angle for both maximum output and alignment designs.

Using the alignment design, there is a small reduction in gain. This gain reduction amounts to about one to two db, in most cases. The horizontal pattern of the alignment design rhombic is some what broader, and the vertical pattern somewhat sharper than that of the maximum output design. In addition, the maximum output design rhombic produces a vertical radiation pattern which, in practice, falls a few degrees lower (or less) than the design angle. For example, our rhombic designed for a vertical angle of 15 degrees, will produce a vertical lobe centered on, perhaps 13 degrees (See **Fig. 6**).

Fig. 7 gives values for both the maximum output and alignment design rhombics.

In military point to point communications, we use several sizes of rhombics that can be utilized for amateur operation. These rhombics were designed to cover a frequency range of 4 to 22 mc. (See **Fig. 8**).

You will notice that the dimensions of these antennas do not necessarily conform to those listed in **Fig. 7**. The reason for this difference is that these rhombics utilize what is known as a compromise design. The compromise design

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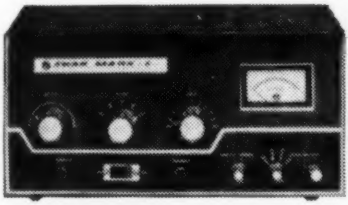

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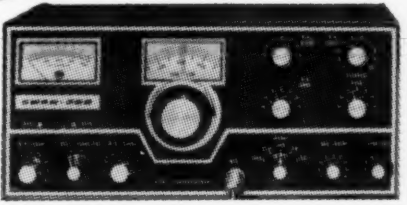

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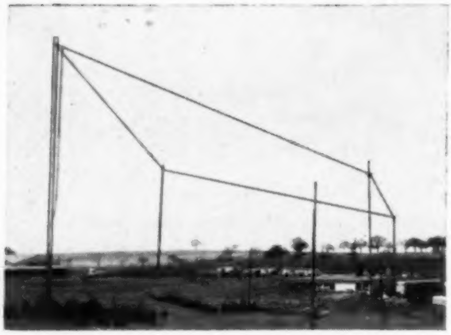


5 wavelength 20 meter rhombic at DL5UW.

provides good gain over a fairly wide frequency range, and at the same time employs reasonable physical sizes and heights.

In our discussion, and diagrams of various rhombics, we have used a single wire or conductor to form each leg of the antenna. Commercial, military, and in some cases, amateur rhombics employ multi-element legs. These multi-element legs are normally made up of three wires of equal length and fanned out from the rear and front poles so that they have a spacing of about 6 feet (vertically) at the point of attachment to the side poles. (See **Fig. 9**). The multi-wire or curtain rhombic has the following advantages over the single wire type.

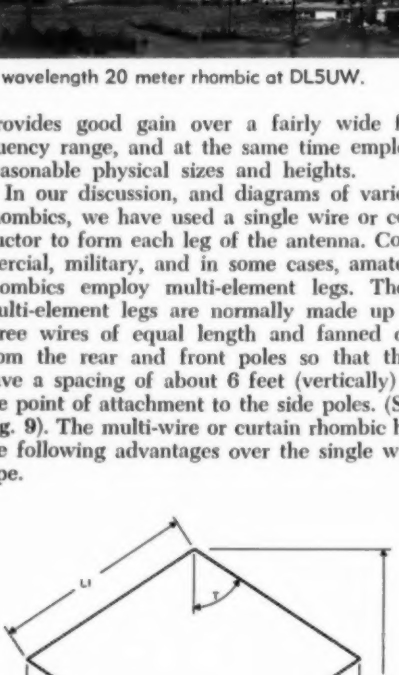


Fig. 8. Compromise design rhombics for 4 to 22 mc.

L1 *Leg Length* *(feet)*	*L2* *Width* *(feet)*	*L3* *Total Length* *(feet)*	*T* *Tilt Angle* *(degrees)*	*H* *Height* *(feet)*
* 375	256	705	70	65
350	241	658	70	60
315	221	590	70	57
290	222	537	67.5	55
270	228	490	65	53
245	226	437	62.5	51
225	225	391	60	50

* This is approximately the same antenna as the one used so successfully at DL4OV. Converting the 375 foot leg length to wavelengths, we have one wavelength per leg on 3.9 mc, 2½ on 7 mc, 5 on 14 mc and 8 on 21 mc.

Wave Angle (degrees)	*Leg Length (wave lengths)*	*Tilt Angle (degrees)*	*Height (wave lengths)*
10	17	80	1.45
12	11.5	78	1.20
14	8.5	76	1.04
16	6.6	74	.91
18	5.3	72	.81
20	4.3	70	.73
22	3.7	68	.67
24	3	66	.62
28	2.3	62	.53
30	2	60	.50

Fig. 7A. Maximum output rhombic antennas.

Wave Angle (degrees)	*Leg Length (wave lengths)*	*Tilt Angle (degrees)*	*Height (wave lengths)*
10	12	80	1.45
12	8.5	78	1.21
14	6.3	76	1.04
16	4.9	74	.91
18	3.9	72	.81
20	3.2	70	.73
22	2.6	68	.67
24	2.3	66	.63
26	2	64	.57
28	1.8	62	.53
30	1.6	60	.50

Fig. 7B. Alignment design rhombic antennas.

a. The input impedance is more nearly constant over a wide range of frequencies.

b. The input impedance is reduced to a lower value, allowing a good match to 600 ohm open wire line feeders.

c. The 3 wire rhombic produces about 1 db greater gain than the single wire type.

The value for termination of a single wire rhombic is about 800 ohms. When this 800 ohm value is used, the input impedance of the antenna is approximately 700 to 750 ohms. This difference is caused by radiation losses in the antenna. The rhombic can be terminated with non-inductive resistors, such as the carbon type. These resistors are available in power ratings of 100 to 200 watts. One combination of resistors for a single wire rhombic is seven 100 watt, 5200 ohm carbon resistors paralled to make a 700 watt, 740 ohm termination resistance. This 700 watt rating will handle a transmitter running a full kilowatt and allow a 50 percent safety factor. Another type of termination consists of a dissipation line. Dissipation lines are sometimes constructed with a pair of number 15 AWG solid stainless steel wires, spaced to provide proper termination impedance. The advantages of this line is that it is 1000 feet long. A more suitable dissipation line can be constructed with number 24 to 26 nichrome wire 250 feet long, with a 20 watt 800 ohm carbon resistor across the far end of the line. (Ten 8000 ohm 2 watt carbon resistors in parallel, for example). Because of the power attenuation in the 250 feet of nicrome wire, the 20 watt resistor will not be overloaded.

The terminated rhombic can be made to switch its beam, or lobe direction by 180 de-

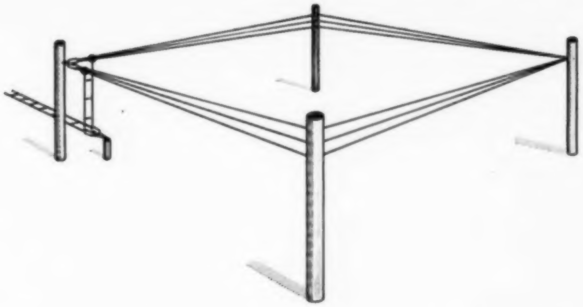


Fig. 9. Three wire rhombic.

grees when the following components are incorporated in the system. First, transmission lines are run from the transmitter to both ends of the rhombic. Then a dissipation line is constructed and the open end brought into the shack, or operating position. If two double pole double throw relays, or switches are employed, the proper transmission line, and the dissipation line can be connected for transmission in either of two desired directions. This switching system is shown in **Fig. 10**.

The resonant, or bi-directional rhombic, unlike the terminated model, must be fed with resonant, or tuned feeders, when operated on more than one band. Open wire line, such as number 14 AWG spaced 6 inches, tuned with a "match box" type of antenna tuner will do the job. When the resonant rhombic is operated on one band only, a matching stub and coaxial cable with a coaxial balun, can be used to feed the antenna.

Good engineering practice calls for a site, or plot of ground that is level and free of obstructions under, and near the rhombic antenna. This, of course, is an ideal situation for installing a rhombic, or any antenna, for that matter. If a rhombic is erected over ground that slopes down evenly toward the front pole, the amount of slope, in degrees, is then subtracted from the design wave angle of the antenna. For example, if a rhombic designed for a 20 degree wave angle is erected parallel to the ground with a 5 degree downward slope, the resultant wave angle will be 15 degrees in the direction of the low end, and conversely the wave angle, if the antenna is bi-directional, will be 20 plus 5 degrees, or 25 degrees from the high end. Another variation, used frequently by radio amateurs, is erection of the rhombic over level ground employing poles of various heights, thereby tilting the entire antenna in respect to ground, in the direction that a lower wave angle is desired. For example, a rhombic with 290 foot legs, and a 67.5 degree tilt angle, (Approximately 493 feet from rear to front pole) when erected on level ground with a 70 foot rear pole, 50 foot side poles, and a 30 foot front pole, will have a slope or tilt in the horizontal plane of about 4.5 degrees.

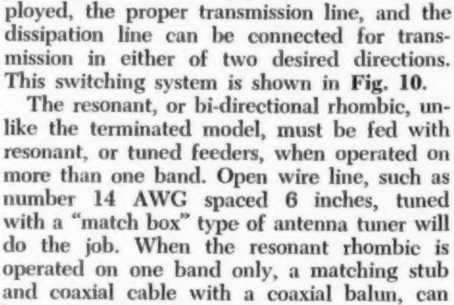
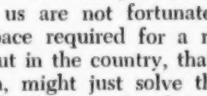


Fig. 10. Switchable terminated rhombic.

Rhombics and V beams that are sloped, or tilted in the horizontal plane so as to produce a lower wave angle in on direction are very successfully operated by W1DBM, 5H3JR, W1BCR and the author, to name but a few.

Many of us are not fortunate enough to have the space required for a rhombic, but that place out in the country, that you've had your eye on, might just solve that problem. We will all be listening for that nice, big, fat signal from your new diamond shaped antenna. . . . WØSII



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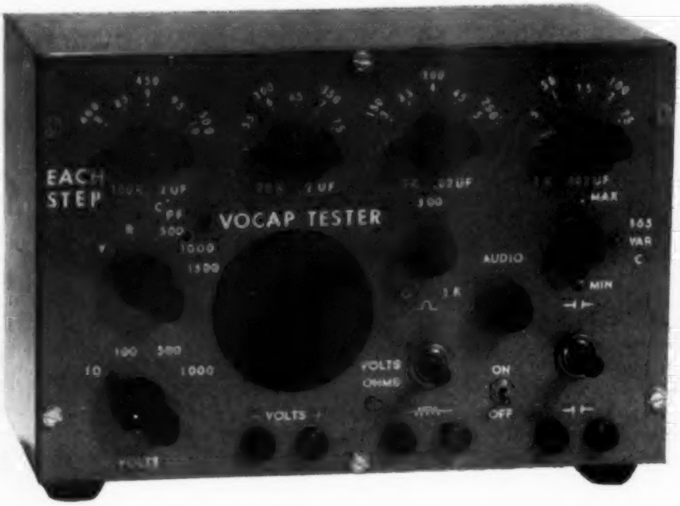


Vocap Tester

This writer has been in orbit so long since his last blast-off that he got lonesome, so he decided to build a music maker. Well not exactly, but a few notes are played while tests are being accomplished. At least it talks back and keeps you company.

The unit is an electronic tester which tests volts, ohms and capacitance without the need of your visual facilities; however your aural facilities must be turned on and in operation. It may be used where total darkness is a requirement or if two meters cannot be monitored simultaneously. Also, a new field may be used where total darkness is a requirement or if two meters cannot be monitored simultaneously. Also, a new field may be opened to the blind.

The unit employes a built-in calibrated tone for each measurement. The item being tested will produce a certain tone and the internal tone calibrator is adjusted until its tone is the same frequency as the tone produced by the item under test. The value of the calibrator will then be equal to the value of the item being tested. It will measure up to 1000 volts dc and also determine polarity, resistance up to 630K ohms and capacitance from 150mmfd to 11mfd.

The VOCAP tester utilizes an audio oscillator which is varied in frequency in accordance with the unit being measured and the internal calibration circuit is adjusted until the calibration tone is identical to the tone produced by the unknown unit. The value of the unknown unit is then equal to the internal calibrated value.

This tester may be used in a dark room; at such a distance, one could not see a meter; while checking two circuits (one with a meter and the other audibly); by a blind person, and by other facilities.

An additional audio oscillator could be built into this unit as a calibrated unit and its tone varied to zero beat with the tone produced by the oscillator controlled by the unknown unit being measured. Again the measured value would be equal to the calibrated unit.

Circuit

The audio oscillator and amplifier use a total of three similar 2N34 transistors. A simple transistorized audio oscillator is the heart of the unit and feeds a signal to a two stage RC coupled audio amplifier which drives a 2½ inch speaker with plenty of volume.

The frequency of the oscillator must be varied over a wide range to obtain greater accuracy from the calibrator system. The frequency of this oscillator can be varied from a few cycles to approximately 5000 cycles. Now there are several ways to change the frequency of this oscillator. Some of the easier ways are: Change the supply voltage, change the voltage applied to the base, change the ratios of the oscillator condensers or change the resistance from transistor base to ground.

The problem of what type of calibrate system should be used raised its ugly head. A bridge type null detector and also a comparative type calibrate system was considered. The unit started out as a volt-ohm tester so a comparative type calibrate system was used, because only changing the base resistance to ground sounded very appealing and simple. Then later, it was realized that when a condenser was placed in parallel with the condenser connected to the base of the transistor oscillator, a frequency change was noted. However, a similar tone was difficult to obtain by changing the base resistance. So due to lack of patience, the problem was solved by using a capacitor comparative calibrator.

The voltage calibrate circuit was the most difficult to design. It was desirous to have one set of calibrate resistors that would work for all voltage ranges. Voltage divider networks were designed that did accomplish this function. It was also designed so the audio oscillator would cease oscillations when the upper voltage limit of each selected scale was obtained. Another added feature, due to the diode and circuitry arrangement, provides a means of determining the voltage polarity. The voltage calibrate switch values are not additive, i.e., only one switch is used to determine the voltage being measured.

The resistance calibrate circuit is very simple. The resistor being checked is inserted in series with the audio oscillator base lead and a comparative circuit is used to determine the value.

The capacitor calibrate circuit is similar in operation to the resistance test except condensers are connected in parallel with the condenser that is in the base circuit of the audio oscillator.

The resistance and condenser calibrate switch values are additive, i.e., a combination of the switch settings will determine the value of the item under test.

Construction

The placement of parts is somewhat critical if it is desired to use a 6 x 8 inch utility box. It is possible to use an all-resistor calibrate system. Some of the resistor values are not standard, so you must get a resistor with a value close to but lower in resistance and then file or saw a notch into the resistor until the resistance has increased to the exact value. Be sure and check the resistance often and

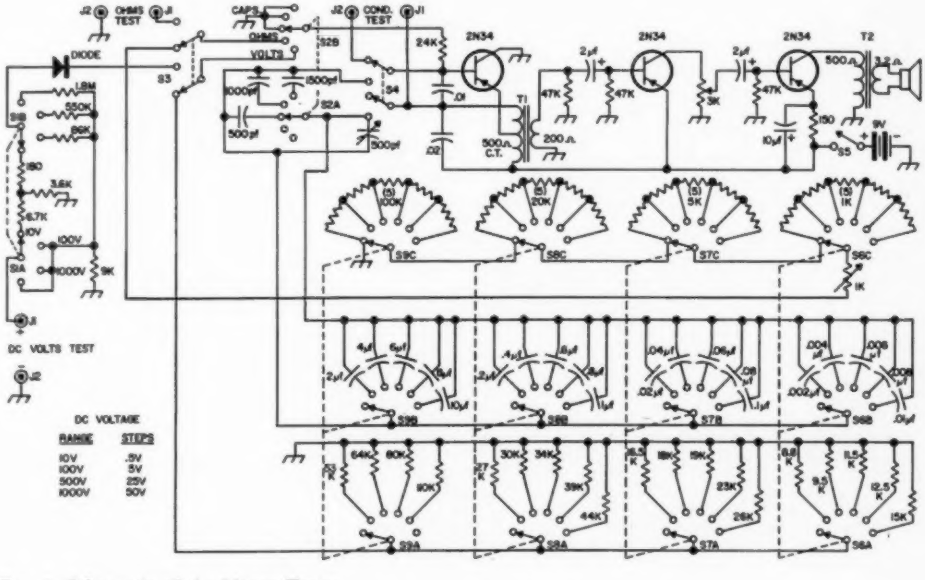

J2 OHMS TEST J1
CAPS
OHMS
VOLTS
S2B
S2A
S3
S4
DIODE
J2 COND. TEST J1
24K
2N34
.01
.02
T1
500Ω C.T.
200Ω
2μf
47K
47K
5K
10μf
150
500Ω
T2
3.2Ω
9V
S5
1000pf
1500pf
500pf
500pf
1.8M
550K
86K
S1B
180
3.6K
6.7K
10V
100V
1000V
S1A
9K
J1
DC VOLTS TEST
J2
(5) 100K
(5) 20K
(5) 5K
(5) 1K
S9C
S8C
S7C
S6C
1K
S9B
S8B
S7B
S6B
S9A
S8A
S7A
S6A
DC VOLTAGE
RANGE STEPS
10V .5V
100V 5V
500V 25V
1000V 50V

Fig. 1. Schematic of the Vocap Tester.

do not file it too much between checks or you may find that you have passed the point of no return. Apply a drop or two of glue to reseal the resistor to prevent resistance change due to moisture, etc. A new Eico VTVM was used to measure the components and the 1K ohmic scale range was used for measurements up to and including 25K ohms. The 10K ohm range was used for values above 25K ohms.

Low voltage condensers may be used which will reduce the size of components. Condensers were used for the calibrate system because the paralleling of condensers would provide a wide range of values.

A bridge type rectifier may be used if ac voltages are to be measured. An ac voltage measurement circuit was not included in the original unit but the writer is in the process of including one in the present VOCAP tester along with an ammeter circuit.

A nine-volt battery must be used with this unit because the calibration system was designed around a nine-volt battery source.

The on-off switch should be included in the volume control and the 365 pf variable condenser should be replaced with a 400 pf variable condenser for easier calibration of small capacitors. The three paralleling condensers would have to be changed to 100 pf, 600 pf and 1100 pf to give the same 500 pf, and 1500 pf ranges.

Operation

1. Voltage Test Procedure

The VOCAP tester is energized by the on-off power switch.

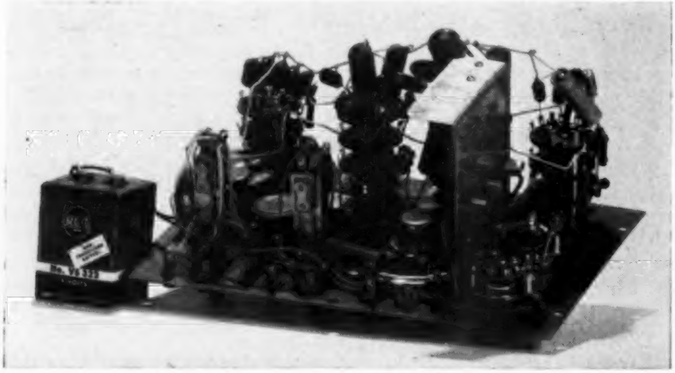
The following switches are used when measuring dc voltage: Voltage select switch, function switch, the four calibrate switches at the top, and the volt-ohm toggle switch. Place all calibrate switches to the OFF position, the function switch to "V" for volts, the voltage range select switch to 1000 volts and test leads connected to the volts terminals.

A tone will be produced, by the voltage under test, when the momentary volt-ohm toggle switch is depressed, which is the test position for checking voltages. The voltage select switch should be placed on the 1000-volt range if the approximate voltage under test is not known, to prevent the possibility of overloading the input circuit.

Correct dc polarity is first determined by connecting the test leads to the unknown voltage so as to produce the lowest pitched tone. The largest test lead jack is the negative terminal.

After polarity has been determined, the correct voltage range is selected by rotating the "volts" switch to the lowest range in which a tone can still be heard when the toggle switch is in test position. The voltage test circuit was designed so voltages greater than the upper limit of each range would cause the audio oscillator to cease oscillating. Example: if the test voltage was 250 volts, a tone will not be produced on the 10 or 100-volt range, but will be heard on the 500 and 1000-volt range. For greater accuracy, use the lowest range that produces a tone.

To determine the value of voltage under test, rotate only one calibrate switch at a time until the calibrate tone is approximately the same as the tone produced by the voltage under test. The value of the test voltage will then be equal to the value shown by the calibrate switch position. Be sure that three of the four calibrate switches are always in the OFF position. The 10-volt range is calibrated in .5-volt steps, 100-volt range in 5-volt steps, 500-volt range in 25-volt steps and 1000-volt range in 50-volt steps.



Here's the inside of the Vocap Tester. How's that for Mil Spec construction?

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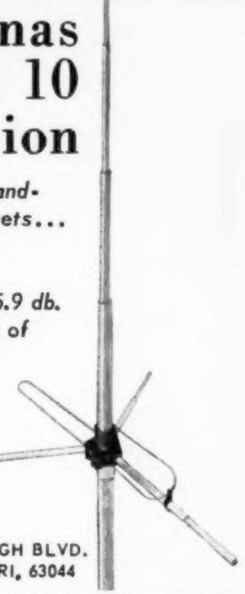

2. *Resistance Test Procedure*

Place all the calibrate switches to the OFF position, the function switch to "R" for resistance, the 1K ohm potentiometer to the zero position and connect the test leads to the "Ohms terminals. Connect the test leads across the resistor to be tested and momentarily depress the VOLT-OHM toggle switch. A tone should be heard. Now, adjust one or more of the calibrate switches (plus the 1K ohm potentiometer if required) until the same tone is produced. By adding up the values of each calibrate switch position, the total will then equal the value of the resistor under test. The 1K ohm potentiometer could be calibrated every 100 ohms for greater accuracy. The range of the resistor calibrator is apprroximately 100 to 630K ohms.

This range could be increased by increasing the number of positions on the left calibrate switch and adding additional 100K ohm resistors. The calibrate switches, from left to right, insert the following resistances in series: (1) 100K ohms each step, (2) 20K ohms each step, (3) 5K ohms each step, and (4) 1K ohms each step.

3. *Capacitance Test Procedure*

Place all the calibrate switches to the OFF position; the function switch to the 500, 1000 or 1500 pf range if small capacitors are to be measured, and if larger capacitors are to be measured, place the function switch to 500 pf range; place the 365 pf variable condenser to the "Min." (minimum) position and connect the test leads to the capacitor terminals. To determine the value of an unknown capacitor, connect it to the test leads and a change in the frequency of the audio tone should be noticed immediately. Now, depress the capacitor toggle switch and adjust one or more of the calibrate switches (plus the 365 pf variable condenser if required) until the same tone is produced. By adding up the values of each calibrate switch position, the total will then equal the value of the condenser under test. The variable capacitor could be calibrated every 100 pf for greater accuracy. The range of the capacitor calibrator is approximately 150 pf to 11μf. This range could be increased by increasing the number of positions on the left calibrate switch and adding additional capacitors. The calibrate switches, from left to right, insert the following condensers in parallel with the audio oscillator condenser: (1) 2μf each step, (2) .2 μf each step, (3) .02 μf each step, and (4) .002 μf each step.

The writer wishes to thank Mr. Dick Azim, K0JEJ, for the fine job of photographing the equipment.

. . . W0BMW

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	301-F	144-146	28-30
	301-Q	144-148	14-18
	301-R	144-148	7-11
	301-S	143.5-148.5	30-35
6M	301-B1	50-51	.6-1.6
	301-B2	51-52	.6-1.6
	301-C1	50-54	7-11
	301-C2	50-54	14-18
	301-J	50-52	28-30
20M	301-G	13.6-14.6	.6-1.6
CB	301-A1	26.5-27.5	.6-1.6
	301-A2	26.8-27.3	3.5-4.0
40M	301-K	7-8	.6-1.6
CHU	301-L	3.35	1.0
WWV	301-H	5.0	1.0
Int'l. Marine	301-I	9-10	.6-1.6
	301-M	2-3	.6-1.6
Aircraft	301-N1	118-119	.6-1.6
	301-N2	119-120	.6-1.6
	301-N3	120-121	.6-1.6
	301-N4	121-122	.6-1.6
	301-N5	122-123	.6-1.6
Fire, Police etc.	301-P1	154-155	.6-1.6
	301-P2	155-156	.6-1.6
	301-P3	154-158	7-11
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Harvey Pierce W0OPA
5372 E. Bald Eagle Blvd.
White Bear Lake, Minn.

The Feedline Argument

One of the perennial arguments on the air is the one of "coax versus parallel line." Perhaps a little history and a few facts about the feeding of antennas might add some fuel and some intelligence to the discussions. Everything said about transmitters except power applies to receivers as well.

First, antennas were erected solely with the idea that the more wire and the higher the wire, the better. No thought was given to feed line because the antenna was grounded and a part of the transmitter circuit anyway; however, with the coming of the "short" waves, it became apparent that the best antenna was a half-wave as high as possible. Of course, the grounded vertical was and still is used, but the half-wire horizontal antenna had to have a feedline. Height had some influence, but was not deemed important.

Right away, it seemed, an argument began: Which was better–end feed or center feed? Also, what was the proper "impedance" of the line? The impedance didn't really matter to amateurs, but the feed point did. If you fed at the end, you needed only two supports for the wire, one at either end; but if you fed in the middle, *three* supports were usually needed, one in the middle to hold up the feedline. The feedline was the same for both.

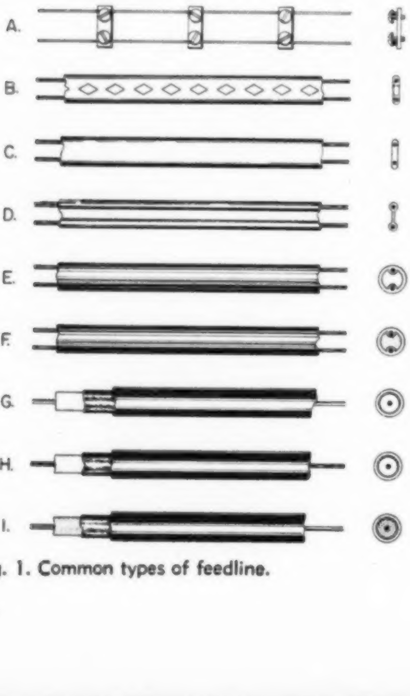

Fig. 1. Common types of feedline.

It was the so-called "ladder line" (**Fig. 1a**) of two wires held apart by spacers. The impedance was often given as "600 ohms," but nobody cared very much. "Standing waves," if thought of at all, were expected and even encouraged. Everyone had an antenna tuner with variable coupling to the transmitter.

The "center feed" side had the best of the argument, it seemed. No matter what frequency was put out, the feedline was always "balanced"; the voltage and current in one wire always canceled out the voltage and current in the other wire. Result–no feedline radiation. This was not true of end-feed where feedline radiation occurred whenever the antenna itself was not exactly a half-wave or multiple of a half-wave long. You rarely hear of an end-fed half-wave these days.

Just before WW-2, somebody discovered that a half-wave horizontal wire (dipole) could be fed with ordinary twisted lamp cord. It was lousy when wet, but was easier than building a feedline. It wouldn't handle a kilowatt either. The manufacturers brought out EO-1 cable, which wasn't very good, but was much better than the lamp cord it replaced; it was the first generally available low-cost, low-impedance feedline.

Then came the War and polyethylene. It and the war-surplus made low-cost feedlines available to everybody, and the arguments started, growing with each new development in feedlines. Today we have lots of lines available, thanks to polyethylene and to TV. See **Fig 1**. We have.

a. Ladder-line, two wires held separated by spacers.
b. "Punched" line, a ribbon type with a

portion of the polyethylene removed.
- c. Ribbon line, of solid polyethylene.
- d. "Dumbbell" line, with the insulation thinned to make it cheaper.
- e. Tubular line, to reduce the effect of rain.
- f. "Foamed" line, lower losses than the tubular.
- g. Solid inner conductor coax.
- h. Stranded inner conductor coax.
- i. "Foamed" coax with less insulation than standard.

The ribbon types we owe to TV and is nearly always 300 ohms. The coax is either about 75 ohm or 50 ohm impedance.

All insulation has dielectric losses, and while polyethylene is good, some kinds have losses that are higher. With air as 1, solid polyethylene (as in the coax type) has a figure of about 2.6 and the nitrogen foamed variety about 1.7. In contrast, the ladder type line has a figure of 1.01 or better. Air is the ideal.

The losses in db per 100 feet increase with the frequency and the amount of insulation. For the lower bands, as 75 meters, it will make very little difference *what* kind of line is used, but on 2 meters it will pay to study the loss figures very carefully. It is very easy to lose three-fourths of your power in the feedline on two meters!

Power-handling capability varies greatly with the type of line in use. It has nothing to do with db loss, but increases with the size of the conductors and the impedance of the line. Always remember that a given line will handle less and less power as the SWR goes up because it is the SWR that determines the maximum current on your line, and the line will handle no more current than the smallest of the conductors can handle without melting or distorting the insulation. A line may be "good" for 500 watts only with a 1:1 SWR.

The SWR on a line increases losses in db, but it is only of importance if the db loss of the line is already high or if it exceeds the wattage rating of the line; otherwise, the SWR on the feedline is of little, if any, importance. If the antenna takes the power, it will radiate it no matter *what* the SWR is.

Nor is the impedance of a line of very great importance except it should match the antenna. These days it is possible in some way to match an antenna to almost any line available. Of course, nearly all manufactured and kit-form transmitters are built to "match" 50 ohm coax. This is the cause of the argument.

A "balanced" antenna—dipole, yagi, quad, rhombic, etc.—requires a balanced line, as ladder line or ribbon. An unbalanced antenna—grounded vertical, groundplane, coaxial skirt—requires a coax line. Transmitters nearly all require coax.

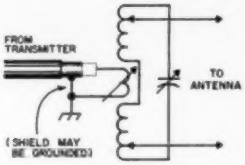

Fig. 2. Antenna matcher.

What is the best type of line? The "ladder" type. With proper type separators, it has negligible loss, is practically unaffected by the weather, standing waves do not bother it, and, being air-cooled, can handle much higher power for a given wire gauge. There are a few drawbacks. The impedance is high, usually 300 ohms or more, and commercial varieties often have plastic separators that become very brittle when exposed to light of the sun. With all types of balanced line, it is necessary to keep the wires of equal length and spacing, several inches at least, away from all conducting objects, and make all turns gradual.

Next to the ladder type line in desirability is the round nitrogen foamed line, then the round tubular line. Both are relatively unaffected by wet weather, with the foam type giving the lowest loss. As with all polyethylene insulated lines, the power and/or standing waves must be kept down to keep from melting the insulation. The flat, or ribbon, lines are the worst (and cheapest) types, very much affected by rain. If you must use polyethylene, be very sure you get the type with an ultraviolet inhibitor that prevents the development of brittleness when exposed to sunlight.

For coax line, be sure it has virgin polyethylene insulation, white or clear, not brown. It needs no additives against ultraviolet or sunshine, being covered. Stranded wire is best for the center conductor in the interest of flexibility. The shield braid should be tight, covering 95% of the polyethylene. The neoprene coating should be of the best, with no plasticizers that will "bleed" into the center insulation in hot weather. Lastly, the nitrogen foamed line is much the best. If you can, inspect a sample. If the different layers stick together, it is old and of poor quality. The impedance, of couse, should be of the proper value.

The big question is, of couse, "How do you connect a balanced dipole to an unbalanced transmitter?" The answer is, "You must use some sort of matching device." The common-

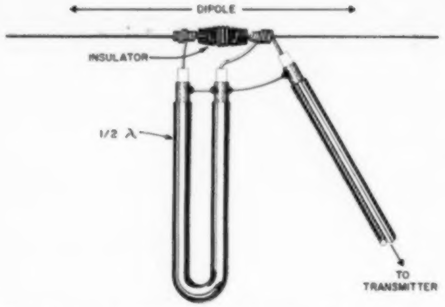

Fig. 3. Coax balun for matching coax to a dipole.

est is either an antenna tuner or a balun. **Fig. 2** shows the circuit of a typical antenna tuner. If you do *not* use a matching circuit, regardless of the impedance, the shield of your coax will pick up a voltage equal to the center. The center cannot radiate, but the shield can and does. This is the reason coax cannot be recommended for balanced type antennas. The radiation can, and sometimes does, "back-up" on the transmitter chassis and the AC line to cause feedback and TVI.

Parallel wire line will radiate whenever the voltage and current in one wire is not exactly equal and opposite to the voltage and current in the other wire. This can come about through unbalanced feed from the antenna ("Windom" antenna, etc.) where the feedline wires are not the same length, or when one wire runs closer to a conductor than the other. When one wire is grounded at the transmitter (a common case), the balanced feed will put rf on the chassis unless the transmitter ground is a true rf ground, which is almost impossible. The result is a likelihood of feedback at the microphone and/or radiation (and TVI) from the power line. Of course, troubles from radiation increase with frequency.

TV producers long ago found out about coax. For years now all TV beams have been of the balanced line type (300), with a wide-band balum transformer to line-type feed to the unbalanced input of the receiver. (Incidentally, these balums will handle low power very well for 2 and 6 meters.)

The antenna turner has the advantage of responding only to one frequency, effectively reducing harmonics. It is unaffected by SWR and feedline impedance, and it will reduce the SWR on the coax to 1:1. (If it does not, the excessive SWR is the harmonic content of the transmitter.) It has its drawbacks, though. It adds two or more controls to the transmitter. It is essentially, even with plug-in coils, a one-band device. (But so is a good antenna.) It really cannot do anything about antenna mismatch and SWR on the feedline.

Coax, such as RG 8/U, can be run anywhere that the insulation will stand, such as inside walls, through pipe, under ground, etc. It will match nearly every transmitter. It is what nearly all SWR meters are built for. With a proper balun it will couple to most antennas. And it will handle a fair amount of power. But it has a pretty high loss at high frequencies and if not balanced, will radiate from the shield.

A ½ wave feedline balun (see **Fig. 3**) is a good device, but only good close to one frequency. It has a 4 to 1 ratio, matching a 300 ohm antenna to an unbalanced 50 ohm feedline. The popular "Gamma" match is good for matching an unbalanced line to a dipole only when the antenna's "neutral point" is thoroughly grounded for rf; otherwise, the shield of the feedline will radiate. Other types of match, such as delta, tee, stub, etc. will radiate from the shild, particularly on harmonics.

On the lower bands, losses in feedlines do not matter so much, but harmonic radiation does. An antenna tuner is the answer. On the high frequencies, a ladder line and tuner can give you three db or more signal. It seems a cheap way of doubling your power.

If you bought your antenna ready made and it calls for coax feedline, obey your instructions. Maybe it was built to use that line and that impedance. If you feel adventuresome or like to build your own, consider the ladder-type line and an antenna tuner. It will practically eliminate harmonics, laugh at any SWR, and reduce losses. Just be sure the wires are of identical length, have no sharp bends, and are evenly and closely spaced. The nitrogen foamed parallel line is almost as good, but has more loss and will not handle the power.

Coax line should be used with some sort of a balun. The ½ wave balun of **Fig. 3** discriminates somewhat again harmonics as well as balancing the feedline output. There is little to be gained by cutting a coax to a certain length for better feed. If it works, the SWR is too high anyway. Coax is a good type of feedline within its limits—short lengths, or low frequencies, with some balancing system to keep the shield "cold", and low SWR—and it matches nearly all transmitters.

I hope the statements in this article will, perhaps, put a few more watts on the air and reduce a few SWR's *and* add fuel to the FEEDLINE ARGUMENT. . . . W0OPA

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Letter from Jail

Wobblywire, Wisc.

Dear John:

You FCC fellers have troubles, but let me tell you about mine.

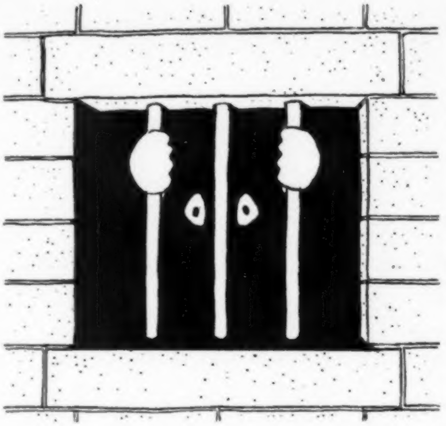
Recently I was mobiling leisurely alongside Lake Snagg at 65 as everyone does, when a crosswind blew my mobile logbook out the window and into the lake. I stopped immediately, as did none of the 13 other cars behind me in my lane. I shouldn't call it "my" lane, but after all the left lane is for passing and I really did intend to pass anyone I might overtake in my V.W.

Remember those stink-bugs that put their heads down and their rear ends up when you touch them with a stick? Well, that is what those cars behind me did. Their front ends tried to kiss the pavement and their rear ends went up. It doesn't take an Einstein to figure out what happened as all 14 of these bugs were moving at 65 except the first one, which was stopped.

There was now no moving traffic, so I pulled into the vacant right lane, stopped, and ran to the lake just in time to see an "eager" beaver grab my log and start to swim away with it. Horrors!! To retain my log for one year I must somehow scare him into releasing it. I threw at him the only thing available, my portable receiver, tuned to the local Jaybird Net. Those with strong stomachs and weak minds can stand this net, but Mr. Beaver had neither. He released the log when the blaring receiver went whizzing by.

What followed was a bit exciting. After the receiver hit the water there was a dandy explosion, caused, Im' told, by the mercury cells. At any rate, my log soon came ashore amid the waves. Drippy logbook in hand, I returned to my car, checked back into the net, and was starting to tell the gang what had happened when some irate clod in the adjacent lane yelled a comment of such amplitude and color it was transmitted at least Q5. Then the patrolman arrested me.

John, I am now in the local Bastile. Let me tell you their ridiculous charges:



(1) "Driving in the wrong lane." I thought it was the left lane. Can you imagine signs reading "Wrong Lane for Passing Only," or "Keep Right, Pass Wrong?"

(2) "Leaving the scene of an accident." What accident?

(3) "Reckless driving." This should be "Wreckless driving," as I was the only one of the 14 who did not have a real wreck.

(4) "Failure to park off roadway." Did they expect me to park in the lake?

(5) "Blasting for fish." Nowhere in the law does it prohibit blasting for logbooks.

(6) "Killing beaver." Mr. B. started this fracas, should suffer the consequences, and did.

Johnny, my old pal, I have another problem. What that idiot yelled was transmitted by my rig, and it obviously was not under my control. As I see it, I have several alternatives:

(1) When my logbook dries out, enter in it the remark in code, so if you birds ever try to nail me for this I'll be ready.

(2) Send a description of the incident, including the remark, to you at the FCC. I could run afoul of the Postal regulations, and a number of FCC girls would handle this letter before it reached you.

(3) Forget the whole thing, and trust you will do the same.

I remain,

Ken W6GTG/9/jail

P.S. You have a paragraph 97.105, "Retention of Logs," and a 97.107, "Operation in Emergencies." As there is no 97.106, possibly you could add one, "Retention of Logs in Emergencies," to cover logs lost to beavers, used for lighting fires, for smoking Bull Durham, as coloring books, flushed down drains, etc. Please!

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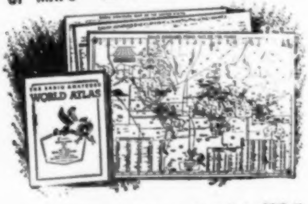

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Ham Ordered to Dismantle Tower

Wm. E. Hough, Jr., of E. Hemfield Township, Penna (call unknown) was recently ordered by the Penna. State Supreme Court to dismantle his 54-ft tower and antenna. Mr. Hough had appealed a ruling by a local judge "that the antenna structure violated the deed restrictions to the Hough home." Mr. Hough stated that he moved into this development area in 1959 after being assured by a real estate agent that no restrictions were made regarding such a tower.

The suit was brought by the owners and developers of the real estate development upon "repeated complaints by neighbors".

The Court's opinion, written by the State's Chief Justice, said in part "it is clear that such a tower with or without the antenna on top does not fall within the permissive structures that could be built on this lot—"

According to the *Daily Intelligence Journal*—Lancaster, Pa. of Jan. 6, 1966, "this was the first case involving deed restrictions affecting ham operators to reach the highest court in any state and will probably serve as a precedent, reports indicate."

IoAr just learned of this suit and the State Supreme Court's decision as we were closing copy for March 73. Further news—as soon as available, direct from Mr. Hough.

IoAR and 73 is indebted to Mr. Ronald L. Herr, Annville, Pa. for alerting us to this momentous court decision.

Get out *your* deed and read the *fine print*!

. . . W7ZC

Historical Note

Roy Thrower WA6PZR

Old timers will remember Phil Spitalney and his All Girl Orchestra, with Evelyn and her Magic Violin. This musical group was quite popular in the late 1930's and early 1940's and made a number of the then popular one night stand tours across the country. Accordingly, the girls traveled in a group of chartered buses.

Old timers may also remember that a number of the gals in the group were radio amateurs. Of course travelling as they did all over the country, it was only natural that the girls installed a mobile station in the rear of one of the buses.

AN OPEN LETTER TO ALL AMERICAN HAMS

Dear OM:

Our Nation is in conflict with Viet Nam. While a declaration of war has not been made by Congress, our commitment and dedication is nonetheless just as real. Historically, our Government has seen fit to ban amateur radio during wartime. So as to defer this prospect, ought we not as active hams demonstrate to Washington that we can voluntarily join one of the quasi-military amateur organizations?

MARS has become an institution in America. It started in 1948 and now includes all branches of the military. Literally thousands of hams are now supporting the Air Force, Army, and Navy MARS organizations.

If you as active hams appreciate your licenses and feel as I do that we ought to use a small portion of this precious right in the morale-building work of MARS, won't you consider giving a minimum of 3 hours of your time per month to this worthy project? Those of you not wishing to join MARS should join in Civil Defense work or Races and put in more than lip service to such a purpose. It seems to me as an individual that if we as an amateur body increase our total membership in these service-connected programs that we will be doing the correct thing and show our Government that we appreciate the privileges and pleasures derived from ham radio.

The MARS programs offer considerable benefits to use individually. After having participated in the program for 6 months you are entitled to take any one of 10 or more electronic correspondence courses from the ECI Institute at Gunter AFB—this at no charge to you. You as MARS members will receive rich satisfaction in learning and using military communications procedures. Because of your involvement in our programs, you automatically will become better Civil Defense operators and even better traffic handlers on the amateur bands. You will use military frequencies set aside in part for MARS purposes. You will qualify, if you are active, in the distribution of Government-issued surplus, but most of all you will help make it possible for our servicemen in Viet Nam and throughout the world to communicate speedily with their loved ones at home, and there is no finer morale-building element than MARS. If you care to accept this general hint, write to me, and I will send you a MARS leaflet with more information, including the address where you can apply for membership.

Herbert Gordon

Sincerely,
Herb Gordon
W1IBY/AF1IBY

P.S. For those questioning my motive in advertising MARS, it is quite simple. Ham dealers can't sell very much gear to hams who aren't allowed on the air; and, of course, I am such a dealer—but there again, I do believe in MARS or I wouldn't have participated in their activities as long as I have.

H.G.

HERBERT W. GORDON CO.,

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It was really an advanced "state of the art" installation, even by today's standards. It contained a number of receiver/transmitter positions operating on several different frequencies.

While there was plenty of room in the rear of the bus for the transmitters, receivers and power supplies, the girls were still confronted by that nemesis of all mobile installations, the antenna.

Considerable intensive research and effort was invested by these female Marconi's to develop an antenna or antennas that would serve in the mobile service and that would resonate on a multitude of frequencies without having to stop the bus and change taps on the loading coil, etc.

Eventually this research paid off. An antenna was developed and proven that had all the desirable characteristics of a mobile antenna. It was compact. It was esthetically acceptable to the most critical individual. And, it had gain! A minimum of three db at its low range of 2 mc and a maximum of twelve db at its high range in the old 5 meter band!

Note that this was continuous coverage—2 thru 60 mc!!! This then was the first, true Broad Band Antenna. . . . WA6PZR

John Fuhrman K0LFA
1526 Que Street
Lincoln, Nebraska

Improving the HX-20, HR-20 and HP-20

Sometime ago, I purchased the HR-20 receiver, HP-20 power supply and HX-20 transmitter. On-the-air reports were very satisfying concerning the quality of the transmitted signal. The receiver's performance compared very favorably with my old station receiver, which was a $250 commercially wired unit.

However, the units have acquired many changes or modifications over the months. Most were to improve on factory specifications or to satisfy my own operation needs. While many amateurs may not want to include the more extensive and difficult modifications, some might find the easier changes may improve their operating pleasure.

The HX-20 VFO was surprisingly stable for a unit built from a kit. However, as the manual stated, the warm-up drift was at least 500 cps or more. Unfortunately, until the unit had been on twenty minutes, the vfo moved across the dial causing many complaints from other stations. For many amateurs this small drift doesn't seem unreasonable but since I must take my operating as I find time, the drift was intolerable.

Upon the completion of a few cut-and-try ventures, the last ditch cure was decided upon: differential temperature compensation.

Many different circuits were built and tried on paper until the final form was developed. The circuit and values are shown in **Fig. 1.** All of the values were calculated to provide a wide enough adjustment of the drift co-efficient to allow for tube and component aging.

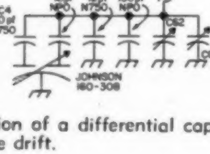


Fig. 1. Addition of a differential capacitor to the VFO to reduce drift.

The differential capacitor is a Johnson #160-308 which is variable from 2.3 to 14.1 pf. It was installed behind the VFO capacitor.

After installation, set the differential capacitor at mid-range and re-set dial calibration using only C62. Allow the new circuit to age for at least twenty hours or normal operation. This will insure "baking-in" of the new circuit.

Exact stability will require a very stable source and scope. I used a 100 kc evacuated crystal standard after a three hour warm-up. The scope's internal horizontal sweep generator was calibrated using the 60 cps test source connected to the vertical input. One sine wave displayed represented a 60 cps sweep rate; two sine waves indicated a 30 cps sweep rate; three sine waves for a 20 cps sweep rate; etc. likewise a 30 cps input will produce one sine wave at 30 cps sweep or two sine waves at 15 cps sweep.

A little experimentation will reveal how easy it is to determine which way the drift is and its approximate rate with respect to time if the simple test set-up in **Fig. 2** is used. I found many times that I could *see* the drift before I could even hear it!

Of course all adjustments must be made with the HX-20 in its case. Luckily there is a mounting hole almost directly over the differential capacitor shaft. Since the differential capacitor is not perfect, its adjustment will introduce some dial error that can easily be corrected by C62.

(In the following paragraphs any reference to vfo drift is made at its operating range of 5.0 to 5.5 mc, not the output ranges of the HX-20 (4.0 mc output = 5.0 mc VFO frequency).)

The position of the N750 capacitors is very important. The rate at which they receive heat from the 6AU6 socket and components is the secret to a low warm-up drift. A movement of ⅛″ will have an effect on their drift rates with respect to time. For example, if the vfo drifts down for the first hour and then drifts higher, move C2 (12 pf-N750) closer to the tube socket.

Before starting any real stability tests, I would like to insert a word of experience: the complete job will require several days and should *not* be done on the kitchen table unless an ample supply of TV dinners are on hand.

Always allow five minutes after any adjustments of the variable capacitors before starting any drift measurements. Their resistance to movement causes them to drift about 50-60 cps back towards their previous settings. A five minute wait will allow them to set-in. All drift measurements should be made from a cold start on upper side band. (The 14 mc LSB crystal drifts aproximately 60 cps from a cold start.)

If the vfo drifts down and becomes stable, rotate the differential capacitor rotor further into mesh with the stator plates connected to C4 (10 pf-N750). If the vfo drifts up, rotate the rotor of the differential capacitor farther into mesh with the stator plates connected to C3 (10 pf-NPO).

If drift cannot be controlled at either extreme of the differential capacitor, increase or decrease the size of C2 (12 pf-N750) as dictated by which extreme the differential capacitor is set at. (The characteristic must still be (N750/C.)

This circuit is easily capable of a 100 cps stability from a five minute warm-up. After one hour the heterodyne crystals in the HX-20 were the primary cause of the remaining drift.

Mechanical instability of the vfo can be improved by a couple of drops of hot candle wax into the center of L15 after final dial calibration. Encapsulating all of the components around the 6AU6 socket with "Q-dope" removed all traces of mechanical instability in my unit.

Operation of the HX-20 and the HR-20 on the 20, 15, and 10 meter bands disclosed a few cycles of drift in the HR-20 between transmissions. Examination of the problem revealed the frequency change was due to the removal of B+ from the HR-20 during each transmission. This slight drift was eliminated by shorting pins 1 and 2 of the VOX relay at the rear panel by connecting pin #3 of J3 in the HX-20. This change left the HR-20 receiver operating all the time, which necessitated a few changes in the receiver to be discussed later. The continuous operation of the HR-20 causes a slight overload on the HP-20 power supply during transmissions, but after one year of operation no component failures have occurred. The plate voltage on the 6146 is still over 600 volts at full load

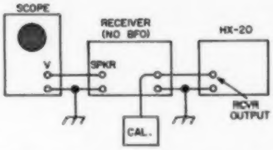


Fig. 2. Adjusting the differential capacitor.

and no noticeable variations in output accompanied this change.

Since most of my operation is on the lower frequency bands, the receiver injection voltage divider at the grid of the 6146 was changed to provide a higher level signal for zeroing. R69 (1000 ohm) was changed to 1 megohm. For this change a pigtail splice is recommended. The very limited space available in the 6146 compartment would increase the chances for component damage if a complete change-out were attempted.

Unfortunately, after this change, a small amount of rectifier hash from the linear was introduced on 20, 15 and 10 meters. However, when I operate these bands, I unplug the receiver from the HX-20 and use the linear's antenna relay. The signal leak through is still adequate for zeroing.

I was unable to obtain full scale deflection of the output meter on ten meters until I replaced R-79 (2000 ohm) with a 20 μh rf choke. Not only was the meter sensitivity improved but smaller amounts of carrier could be used for tune-up, thereby decreasing the chances for tube damage due to out resonance operation during tune-up. The extra meter sensitivity also showed me that I had poorly aligned one of the traps in the 6AW8 mixer stage.

For the proper setting of the carrier crystal on the slope of the crystal filter, I used another receiver and "moved" the crystal around until the sideband quality and unwanted sideband suppression suited me. After doing this the carrier rejection was very poor and the carrier null potentiometer was rotated to one end of its range. Several ideas were tried in an effort to find a way to suppress the carrier without disturbing the carrier crystal frequency. The end result was changing R17 (200 ohm) to 380 ohm. This seemed to be the best and simplest solution. Several tests, on the air and into a dummy load revealed the carrier rejection to be as good as or better than the sideband suppression. On the air reports were obtained while driving a 500 watt linear.

While setting up the combination to drive my linear in a permanent location, severe problems were encountered in the voice control circuits. The HX-20 would cycle wildly

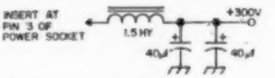


Fig. 3. Additions to the HP-20 power supply.

or hang-up after each transmission as long as the linear was used.

My antenna relay control voltage is derived internally from the linear and tests revealed rf on the control line as the cause. By-passing each side of P2, the external relay control plug, with .01 µf disc ceramic capacitors ended all difficulties.

After adding the shorting jumper in the HX-20 to leave the B+ applied to the HR-20 during transmissions a few changes had to be made to allow for audio output transformer protection and avc overloading.

The first transmission after installing the jumper in the HX-20 was accompanied by a rattle from the audio output transformer of the HR-20. A little searching revealed that although the eight ohm output was grounded during transmission, a voltage was being developed between the grounded 8 ohm tap and the 500 ohm output. Rather than extensively re-wire the HX-20 control relay, a 1000 ohm ½ watt resistor was added from the 500 ohm tap to ground at the headphone jack in the HR-20 (J3—the white lead is the 500 ohm connection). This load did not upset the audio level or anti-vox gain and, in my case, improved the HX-20's ability to withstand static crashes without tripping.

With the receiver operating during transmissions, the avc on "slow" was almost useless because of the long discharge time before enough gain was restored for normal copy. To make the slow avc usable on SSB again, the slow avc capacitor, C57 (0.5 µf) was changed to a 0.25 µf/200 v Mallory PFC Mylar type. I used the Mylar type because of its smaller size.

The very high gain of the 6EB8 triode-pentode combination was really a blessing in disguise. Without a load or at full gain the stage was so hot that it oscillated or "rang" from regeneration. Unfortunately, this extra gain also caused transients to be introduced to an extent that operator fatigue was noticeable.

To put this extra gain to work for me, 15 db of negative feedback was added.

I connected a 560K resistor and .01 µf capacitor in series from pin 1 to pin 9 of the 6EB8. This addition relieved the transient responses and regeneration tendencies.

In my opinion, any station worth its call letters should have an independent signal standard for dial calibration and alignment purposes. Because no provisions had been included for a 100 kc standard inside the HR-20, I modified the Heath HRA-10-1 100 kc Crystal Calibrator for use with the HR-20 receiver.

The HRA-10-1 was assembled according to the manual, except that the bottom plate with the octal plug was discarded and a solid blank was made to replace it. All of the power and output voltages were carried using three conductor cables, one conductor shielded. The shielded conductor was used to carry the output to the antenna terminal, J2. Heater and B+ were carried on the other two conductors.

The unit was mounted to the rear of the 3 kc bandpass filter. The 6-32 hardware was removed from the internal chassis shield and replaced with a metal screw into the side of the HRA-10-1 case after drilling a pilot hole in the HRA-10-1. A quarter inch hole was drilled through both chassis to pass the power cable. A ⅜" hole was drilled in the chassis base center section to pass the shielded output lead to the antenna input, J2. The heater lead was connected to the heater off-on switch at the back of the volume control (this lug has a brown lead from the cable clamp on it). The B+ was carried to the inside of the product detector shield.

The SPDT sideband crystal selector switch was replaced with a DP-4 position, 30° detent rotary switch. The B+ lead to the control switch was run in from lug 1 of terminal strip F. Since this unit was wired for 12 volt operation, the 6BA6 was replaced with a 12BA6.

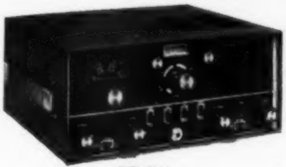
This arrangement provided me with upper-lower sideband plus calibrator by simply rotating the sideband selector switch one position past the old stops.

The 3 mc crystal band-pass filter *if* frequency allows centering the calibrator signal in the passband by listening to the heterodyne between the 3 mc leak through and the desired 100 kc harmonic of the calibrator if the AM detector is used.

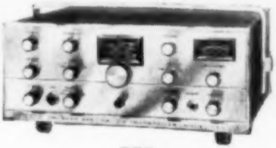
To further reduce hum on the suppressed carrier and the receiver audio, the three hundred volt supply filter was modified to include a 1.5 hy @ 200 ma choke and two 40 µf @ 450 v dc electrolytic capacitors (**Fig. 3**). The choke was added by moving the bleeder resistor to one side while the two electrolytics were placed over the other two 40 µf @ 450 v dc capacitors already in place on the under side of the chassis. While the change was undetectable to many observers, the local operators were able to notice the difference.

. . . KØLFA

TRANSCEIVER HIT PARADE



SB-34



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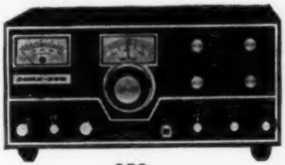

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Write for our Special Transceiver Packet

Dear OM:

This months listing has a good selection in all categories of amateur equipment. You have but to look for yourself to know that our prices are right.

73, Stan Burghardt, W0BJV

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The Walky-Nosy

If you have ever done any emergency communications work in a local two meter net, you have probably wished for a small, compact battery operated receiver with which you could monitor net activities while you covered your duty area.

And perhaps you have also wished for a means of tying your own emergency contributions in with the local police department or other local authorities such as fire and public safety operators.

The receiver-conversion suggested here will solve this problem for you, and give many additional surprises.

Like many ardent VHF enthusiasts, I was curious aobut the high-end receiving capabilities of the many Japanese FM portable radios. A dozen or more U. S. importers have flooded the U. S. market with 9 to 11 transistor FM and AM/FM battery operated-hand carried portables. These units vary in design detail, but all follow a basic format. They cover the 88-108 megacycle FM range; have a transistor RF stage, two or three stages of *if* and some method of FM detection that varies from slope detection with a standard AM detector circuit to a quadreture coil arrangement for pure FM detection.

You will find these little import sets at the nearby Lafayette store, the corner drug store and the local camera shop not to mention the chain discount stores. Prices vary from $20.00 to $40.00.

These receivers fall into two broad categories. Those which can be easily converted to high band (115-165 mc) reception, and those which cannot—easily. Those which cannot be easily converted are easy to spot; they feature a sealed front end-mixer-oscillator arrangement all neatly packaged up in a small plastic container. The top of the container is always studded with four to six small screws, which in reality are adjustable capacitors in the various RF, mixer and oscillator circuits. Stay away from this type of receiver for conversion possibilities, unless you are prepared to tackle the dismantling of the small plastic sealed box (not recommended!)

The convertible type are equally easy to recognize. The RF amplifier circuit (with coil), mixer and oscillator circuits (with coils) are all out in the open.

The only work you will need to de to convert such a unit to tune any 20 mc segment between 115 and 165 is to raise the operating frequency of the RF amplifier circuit, the mixer circuit and the oscillator circuit.

Conversion

Our "case conversion" will be around a commonly available import, the Claricon model 46-045 AM/FM portable receiver.

The procedures outlined for this receiver have been successfully adapted to a number of other import units, such as the Lloyds TF-911 series set.

We have converted nearly a dozen Claricon sets to everything from aircraft (115-135 mc) to fire and police (155-165) and can recommend this model completely for ease of conversion and stability of operation after conversion.

The Claricon model 46-045 operates from four type "AA" penlight cells, 6 volts dc total. Current drain is sufficiently low that one set of batteries has run as long as 8 hours a day for two months on the local police frequency without signs of voltage degradation.

This unit has a 10.7 mc *if* (three stages no less), adjustable discriminator circuit, built-in 27 inch whip, carrying handle and earphone with jack.

First open the back of the case and identify the conversion components: the antenna coil, RF amplifier coil and oscillator coil.

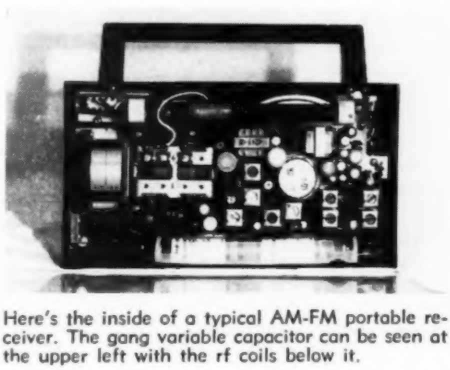
The RF amplifier transistor has a multiple turn antenna coil at the base of the 27 inch antenna. This coil is a 3½ turn airwound coil ⅛th inch in diameter.

Table one shows that to convert this circuit to 150 mc operation is will be necessary to reduce this coil to 1½ turns overall. You can reach 1½ turns overall by shorting the three full turns together, to form a single turn.

(NOTE: the 150 megacycle region will probably be the most common conversion because this region contains the frequently utilized police, fire, public safety and business radio services.)

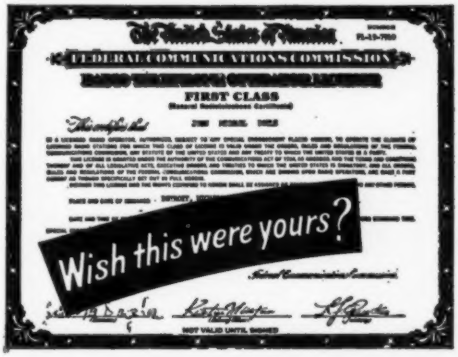
Next stop is the FM rf coil. This, in the Claricon receiver, is the 5 turn center tapped ¼th inch airwound form. One turn must be removed from each side of this center tapped coil. If you choose to merely short two turns together to lower the inductance of the coil, use a very fine file or emery board to clean the protective coating from the turns before soldering.

Last stop is the FM oscillator circuit. This is a four turn coil on a 5/16's form, mounted upright on the circuit board just to the right



Here's the inside of a typical AM-FM portable receiver. The gang variable capacitor can be seen at the upper left with the rf coils below it.

You earn your FCC First Class License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Coil Information

Antenna Coil	RF Coil*	Oscillator Coil	Peak Receiver Frequency
1½ t.	3 t.	3 t.	160 mc
1½ t.	3 t. ***	3 t. **	150 mc
2¼ t.	3¼ t.	3¼ t.	140 mc
3 t.	3½ t.	3½ t.	130 mc
4 t.	4 t.	3¼ t.	115 mc

* — Center-tapped coil (coil information is for total turns, with tap in center

** — Re-tune oscillator slug from peak 160 mc reception

*** — Re-peak trimmer mixer section padder from 160 mc setting

of the gang variable (looking at the receiver from the back and bottom, as shown in the photo).

A 60 pf condenser ties the top of this oscillator coil to the variable capacitor, tuning the oscillator over the appropriate frequency range. Exactly one turn from this coil *(taken from the top end)* will move the oscillator tuning range upwards to approximately 140-150 mc.

A small trimmer across the oscillator section of the variable capacitor will pull the center oscillator range over approximately an eight mc range (plus or minus 4 mc). Using a non-metallic tool, turning the trimmer clockwise lowers the oscillator frequency while rotation counter-clockwise raises the oscillator frequency.

Tune up procedure for the converted receiver will probably take longer than the conversion mechanics.

If you live in a population center, there will be many high band signals on the air for tune-up purposes. With the back off the receiver, but the telescopic antenna extended and the antenna lead-in wire inserted in its jack, tune up may begin.

The oscillator should be turned clockwise as far to the right as its will go, without applying any pressure to the slug in the tightening process.

Now look for a small padder variable across the mixer section of the variable gang capacitor located at the top left of the variable.

Using a non-metallic tool, tighten this variable clockwise to the right also, until it comes to a stop.

Turn the receiver on and with the dial set in the mid-region (i.e. approximately 100 mc on the FM dial) advance the oscillator slug counter clockwise by ¼ turn.

Now return to the mixer trimmer and advance it counter clockwise very slowly listening to the rush of background noise coming from the speaker. You should be able to detect a slight but noticeable increase in background noise very shortly after you start counter clockwise rotation. If you do not notice a rise in noise, set the padder approximately 20% of one turn counter clockwise from stop and leave it for now.

Return to the oscillator slug. Using the non-metallic tool once again, rotate further counter clockwise very slowly. At some point between ¼th turn from stop and ¾ turn from stop you will begin to hear a multitude of off-the-air signals. Note the range through which you can swing the slug and hear the signals, and then set this control to the mid-point of this range.

Now return to the mixer trimmer and touch up the tuning of this padder by picking a weak signal in the middle of the dial, and tuning for maximum signal.

At this point you have a fully converted hand carried police, fire, aircraft (or whatever) receiver suitable for metropolitan area use anywhere in the United States.

You may wish to touch up the tuning of the adjustable discriminator, and to do so you merely insert a non-metallic tool into the pink colored slug tuned *if type* can on the right hand edge of the receiver, and tune for best audio.

Results

With the converted receiver sitting in the seat beside us in the car and the earphone in our ear it is painless to copy the local 250 watt 155 mc police dispatcher 6 to 10 miles away. And this is with my portable receiver and antenna completely encased by the metal body of the car!

Background noise is very low under no signal conditions, so this unit also makes an excellent (although unsquelched) base receiver for home or office reception of local high band calls.

Because the unit is designed around a true quadreture coil FM discriminator, you would *not* expect it to respond to AM signals, such as you find in the aircraft services between 108 and 135 megacycles and the 2 meter band. Not true. Aircraft reception is especially good, as witnessed by my consistent (although slightly noisy reception of Sacramento, California approach control over 90 miles to the north, using just the simple 27 inch whip antenna on my workbench.

Someday, perhaps soon, an enterprising Japanese manufacturer will design and import to the United States a high band receiver for the business and casual listener. Until he does, however, you like me will receive many hours of enjoyable (and downright fascinating) high band listening wherever you go with a converted FM portable receiver, as outlined here.

. . . K6EDX

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FEDERAL COMMUNICATIONS COMMISSION

Ken Cole W7IDF
P.O. Box 3
Vashon, Wash.
Drawing by K3SUK

Our Friend, The R.I.

Upward and onward with the FCC

"The Eyes of Texas Are Upon You" may remind Congressmen of L.B.J.—to me it means G.B. and a memorable conversation with a ham.

His name was Guzz Brewer W5DAA, and seven days later a QSL arrived confirming our ten meter contact. On the eighth day I received an official notice from the Kingsville, Texas monitoring station also reporting reception of W7IDF. On 21012 kcs. At that time the fifteen meter band had not yet been assigned to the amateur service, and this second communication from Guzz was signed: "Henry L. Brewer, Inspector."

That was a bad day, but the coincidence emphasized the warning, and I like to think that it is partly due to having met Guzz and Henry Brewer almost simultaneously that I've managed over the years to keep my spurious emissions to an acceptable minimum.

In my QSL file W5DAA's card is stapled to the official notice, and when I came across it the other day it occurred to me that our hobby would be in a far worse mess than it is if our governing authority were not dealing conscientiously with an onerous and thankless task. One thought led to another until I was left with the conclusion that, as an average ham, I knew too little about the Federal Communications Commission. This is a deplorable situation, and rather difficult to understand, for in other areas of regulated activity the subject citizens generally know quite a bit about the authority under whose jurisdiction they operate. The policies and plans of commissions and agencies such as the ICC, SEC, AEC and FAA are subject to constant appraisal, analysis and criticism by the interested public. Even the reputed views and personal inclinations of the influential officers are examined by hard-nosed reporters and rather less objective lobbyists. But with respect to the salient workings of the FCC only the interests of commercial communication and broadcast are served by probing trade journals and newsletters. Newton Minow apart—and I salute his audacity—the lively art of public relations has been neglected by the FCC. The amateur community in turn largely ignores the Commission, except when taking sides on specific issues. The ARRL is familiar with Commission headquarters, but like a good gray night watchman making unobtrusive rounds with an eye for trouble, voiceless except to cry alarms. Consequently a quarter of a million hams are pretty much in the dark about the arm of government assigned to manage our affairs.

I think this is regrettable for a number of reasons, and the least of these is the perennial pressure on the FCC to relieve us of some of our frequencies. Ultimately it is the efficiency of the Commission in doing its job that determines the true value of the allocations we hold, as well as those set aside for the broadcast, industrial, safety and other services. I would suppose the efficiency of the FCC depends on the funds appropriated to it, the staff and the size of the job. Well, if you investigate these factors you will find what seems to me to be a curious state of affairs.

Let's go back a bit for a starting point. Not long before the second World War I struggled through the examination for my first ham ticket in the Seattle headquarters of the Fourteenth District. The Commission offices occupied a corner of the top floor of the Federal Office Building, and the staff included four engineers and three clerical assistants. Today, well into what we may as well call the Electronic Age, the transmitters in the United States total 1,475,434—twenty two times as many as there were in 1940. A proliferation of inventions has resulted in new modes, new problems and stricter operating tolerances; in general a difficult job has been made almost impossible and the future promises more of the same. In the Commission's Fourteenth District the federal government has met this challenge head-on by not cutting down on the size of the staff employed here a quarter of a century ago, and the very modest office space has not been reduced. Indeed, during visits to renew amateur and commercial licenses I have noticed very few changes. Knowledgeable, friendly and harassed Engineer-in-Charge L. C. Herndon has been superseded by knowledgeable, friendly and harassed Engineer-in-Charge Herbert Arlowe, and the view from the top floor gradually is being lost to the rising skyline of the city.

My experience with the FCC has been limited to the Seattle office, but the national picture is more important so let's take a look at it, remembering that in 1940 life in the world of wireless was simple; tried-and-tested modes were the rule and there were less than 68,000 stations on the air in all services. The Commission did the job then with 625 employees, although they could have used more. Today, twenty five years later, there are 1,498. In 1940 the Commission was given $1,838,175; in 1965, $16,985,000. Another way of saying it—and I can think of a third way—is that to cope with twenty two times as many stations and the headaches of a technological revolu-

Joystick
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Reviewed in
NEW PRODUCTS
page 115
November 1965

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4,000 licensed stations and SWLS all over the world have already found that this is the first major break-through for 20 years in the field of aerials. The performance for such a compact unit is staggering. Even the skeptics have been convinced once they have understood the basic principles and have followed the simple 'load and dip' procedure given in the instructions.

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INDOORS—ZL4GA's JOYSTICK got him 569 on 3.5 mcs from G5WP on 21st February, 1965 at 0850 GMT. Alan had worked VE7BIY on 3.5 mcs at 559 and also logged 59 countries on 14 m/cs by that date, including LU1HBS and 9M4LP. *Testimonials continue to pour in—read W7OE's fantastic results!*

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tion the FCC is allowed less than ten times the 1940 appropriation, and it's paid in smaller dollars. The "user fees" inaugurated recently by the FCC will aid but will not defray a significant percentage of the overhead. As for the hired help, today the Commission has 2.4 employees for each one on the rolls a quarter of a century ago.

Incidentally, the FAA also has proposed "user fees" to help pay the bill, and this reminds me that this year the FAA will be employing slightly more than 46,000 people—about thirty times as many as the FCC. The FAA appropriation of $751,250,000 is nearly forty five times the Commission budget. Invidious comparisons are usually unfair or set up with some mischief in mind, but the purpose of this one is just to put a train of thought on the track—I'm more disgruntled than envious. In 1963 there was one FAA employee per 1.9 civil aircraft; the FCC has one employee for each 1,500 licensed stations. Of course I wouldn't suggest the FCC headquarters be weighted with retired military brass, paralleling what may have been only a happy accident and not an FAA stratagem. That would be as gauche as remarking that among Congressmen one finds more evidence of proprietary interest in broadcasting then airlines. For whatever reason, in contrast to more robust agencies, distinctive austerity seems to be the lot of the FCC when Congress weighs out the fiscal funds.

In spite of being short-handed and strapped for ready cash the FCC functions. Commission personnel are organized in four operating bureaus, and one of these is Field Engineering. In its Information Bulletin No. 3-G dated January, 1965, the Commission says that more than one fourth of its employees are in this bureau, so presumably four hundred would be a generous estimate. Defining its work assignments, the bulletin continues: "It is engaged largely in engineering work. This includes monitoring the radio spectrum to see that radio station operation meets technical requirements, inspecting radio stations of all types, conducting radio operator examinations and issuing permits to those found qualified, locating and closing unauthorized transmitters, furnishing radio bearings for aircraft or ships in distress, tracing and remedying causes of interference to radio communication, doing special engineering work for other Government agencies, and obtaining and analyzing techical data for Commission use." Quite a workload for four hundred men spread out over the United States, remembering that whole systems we accept as commonplace today were experimental or even unknown in 1940. The

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microwave explosion, lofting of communication satellites, new transmission techniques and accelerating Defense Department demands on the spectrum are only a few of the most recent headaches for the Commission. The Field Engineering Bureau must remember 1940 as the last of the good old years, for in the next twelve months the first commercial FM station was licensed and the first commercial TV broadcast started us on the long trek to Newton Minow's Wasteland. Today there are nearly 1200 FM and 564 TV stations. Industrial and safety services have expanded tremendously; interference control work uses up valuable man-hours, and the Citizens Radio Service daily challenges the Commission's authority. Allocation, compatibility and monitoring problems will multiply as the state of the art advances.

Let's join hands and observe a minute of silence while we contemplate the chaos our panadaptors would display if Commission personnel weren't knocking their brains out housekeeping for us. Then let's tip our collective hat to the R.I.—if Congress continues to neglect the FCC we may have to pass it around to keep him in business.

. . . W7IDF

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(W2NSD from page 4)

Modes All cards submitted for a certificate must specify the mode used in transmitting and all must indicate the same mode. Separate certificates will be available for CW, Phone and RTTY. There will be no differentiation between various phone emissions such as AM, SSB, NBFM, etc.

Time Limit All contacts must be after May 1, 1966 and contacts within any one calendar year will count for that particular year. Cards will not count for more than five years. This means that contacts made in 1966 will count towards the certificate only through 1970.

Bands All cards submitted for a certificate must indicate the band used for the contact and all must be for one single band. Different certificates will be available for each band.

We have no plans for issuing certificates for multi-band countries or for phone/CW countries. QST handles these hydrids reasonably well and we certainly don't want to duplicate their certificates.

We've done a lot of figuring to see how little we would have to charge for these certificates. It would be nice to send them out free, but the money for them has to come from somewhere and no angels have volunteered as yet to foot the costs. By the time you add up to the cost of buying the certificate blanks, setting the type, making the photo negatives, stripping the negatives, making the printing plates, printing the certificates, filling them out, addressing them, mailing them, postage, mailing tube, hand lettering calls in on the certificates, keeping the many records, and a lot of miscellaneous items it comes out to about 90¢ plus per certificate. No doubt we will be accused of crass commercialism for not giving these away, but we'll have to live with the criticism and charge one dollar per certificate . . . or seven IRCs for DX ops.

We'll do our best not to make a CQ out of ourselves with the QSL cards. You'll get them back in short order if you include a SASE (self-addressed stamped envelope) and an original plus a duplicate of our certificate record form. We'll send you the record forms starting in June if you send SASEs for them.

No doubt we will have a lot of questions to answer about this and probably have to come up with more detailed rules as exceptions rear their ugly heads. The purpose of the certificates are to try to make your DXing more enjoyable.

We'll no doubt make quite a fuss over the first chap to submit 100 cards all dated after May 1st. In case of tie we will look for the postmark. Gus plans to list the top certificate holders for each band and mode in 73.

By using the country lists of national amateur groups we have no problem of getting on the hook enjoyed by Bob White at QST. We do reserve the right to be as dictatorial as Bob, but I doubt if we will exercise this right. There will be one major difference between DXCC rules and ours: stations aboard ship within the territorial limits of a country will count for that country. This is not so much of a change as it is a recognition of a fact of life. Up until now there have been several "countries" accepted for DXCC that actually were operated from aboard a ship at anchor. We feel that if the fellow is there it should count and no manure about it.

Somewhere else

In recent years we've had the interesting spectacle of DXpeditions that weren't exactly where they were supposed to be. The temptation is a strong one, of course. Just put yourself in the position of a DXpeditioner . . . you are sitting on some remote spot signing a fine exotic DX call and everyone is calling you like mad. Then after a few days you find that you've worked out the bigger pileups and are now down to the low powered non-DXers who like to pick up a country, but don't really care that much about it.

Well, you've got to pack up all that damned equipment, get it loaded onto a boat, sail for a few days and then unload it all again onto some deserted island or some place where the natives can hardly read or write and put up your antennas, etc. Wouldn't it be a lot easier to sit back with a book for a day or two and then fire up again with the new call? No one but you will ever know, so what's the difference if you are a hundred miles one way or the other?

My question is this: does it make any difference? Several thousand fellows have worked a "new country" and it has been accepted by the League . . . everyone is happy . . . right?

Of course this sort of thing can be run into the ground. With the QSL manager type of operations that we have today almost any bootlegger could, with the help of a friend . . . or even alone . . . give us quite a rash of new countries.

Bootlegging may turn out to be a way to beat the high cost of QSL's. Apparently the League is solidly behind the $25 per QSL concept, if we are to believe the interesting and illustrated talk given by one of the DXCC Committee at the Miami Hamboree. Or per-

(continued on page 118)

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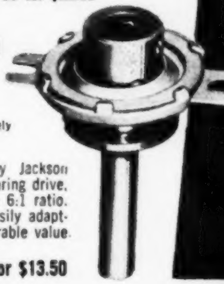

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David Middelton W7ZC
Springdale, Utah

Those Good Old Ham Bands!

Have you taken a serious look across any ham band lately? Or are you one of those "restricted frequency" operators who listens and works only on a few kilocycles?

If you are concerned with the present state—and the future—of amateur radio, you'd better take some time off from those round tables, traffic relays or phone patches and see what is actually happening on your AMATEUR bands.

What you will hear will shock and rock you! It will make you wonder, (if you have been on the air more than a couple of years)—where *are* those good *old ham* bands?

A listen on 40 or 80 will open your ears and make you wish for the OLD Bands more than ever.

The shocking truth is that 40 and 80 are NOT *ham* bands any longer—at least not the type ham bands we had which made ham radio a lot of fun and use!

Long concerned with this problem, I recently was piqued by a note from W2NSD/1—"Nov. 18—tonight I tuned from 3800 to 3900 kc and heard loud commercial RTTY or CW signals on fourteen spots. Each of those signals took up from 3 to 5 kc. Therefore—60 to 75 kc of these 100 kilocycles were unusable for amateur use!"

So, on the evening of Nov. 30, I tuned clear across the 40 meter band, from 7.0 to 7.3 mc and I counted FIFTY ONE non-amateur signals, on ONE trip (15 minutes) across the band. These included propaganda stations, jammers, RTTY and CW (commercial type) plus a lot of unidentifiable crud. These signals occupied from one to 10 kc, so there was not much room for amateur operation.

Or was there? This one trip across 40 meters (as mentioned above) revealed a terrific lot of amateur QRM with stations piled up in heaps, both on CW and 'phone, and with empty space where one could drive a Mack truck through—except for the non-amateur stations lying therein. Many of those non-amateur signals could have easily been overridden by even a moderately strong ham signal, but no Amateur was using these frequencies!

Why?

It has been noted by those concerned with such goings-on, that ANY band tends to become cluttered and QRM'ed with roundtables, traffic and RCC nets, or DX pile ups—in discrete spots on the band, and with most of the band wide open, except for non-amateur use or at times with NO one using these frequencies.

Calls in those "holes" are usually rather non-productive to a CQ. This is a complete mystery to many experienced operators. Having grown up on the bands when EVERYONE tuned all over the band—(or else he didn't work anyone) I am amazed to find this crowding technique operating to severe detriment of amateur radio.

True, some of the non-amateur signals, (and most notable our very own VOICE OF AMERICA stations) are impossible to work through. Surely there are other frequencies being used for non-amateur operation that could and should and MUST be occupied by US—the amateurs. It is our band, too!

Is it *timidity* that keeps amateurs off these frequencies. Perhaps it is, in part. This constantly growing tendency of Americans to be non-controversial about *anything* has innoculated some of them even to refraining from fully using their own bands.

Is it *ignorance?* Ignorance of why this non-amateur is there, on our ham band? Perhaps so, however anyone worthy of holding a license can easily determine in a few short seconds if the signals are legitimate amateur operation or not.

Is it the present and increasing trend of an *inability* to copy through QRM? If this applies to you—then you better turn in your ticket! You do not deserve or are you entitled to a "clear frequency" in spite of the shouts of those ubiquitous phone-patchers.

Copying through normal QRM (NOT the *deliberate* QRM generated by some so-called amateurs today) has always been an operator's greatest asset and achievement. It was not until after WW2 when the GI-trained hams hit the air, that we ever heard anyone demand

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"a clear frequency". If you could hear them, you read them—it was as simple as that. The best filter in the world is between your ears. Couple that with mechanical or crystal filters —and any *good* operator can take a lot of copy before he yells uncle!

So—you listen for these holes, determine that the incoming signals are non-amateur in origin from some guy who is too timid to call CQ, —and pour on the coal! You might get a reply but who chanced to forget that he is Casper Milquetoast long enough to give you, O Brave One, a call—and a good QSO result! Try it and see!

We Amateurs had better OCCUPY all the space on the bands we have now—or we may not have *any* space, tomorrow!

The intruders and the Institute

If you want to help—take a trip across any of the bands with which you are familiar. Note the time, frequencies and type of non-amateur signals you hear. List this information in a legible manner and send it to IoAR HQ. When we receive enough such data, it will be gathered together and sent to Washington, D.C.

The IoAR IS concerned and would appreciate YOUR cooperation in this program, whether member of IoAR or not.

. . . W7ZC

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Low Pass Audio Filters

The FULL Story

A low-pass filter (the audio variety, rather than the rf version) is an integral component of every amateur station, yet almost none of us have any real understanding of how they work.

While the filter mentioned a second ago is the one which takes the ripple out of the power supply, low-pass filters for use in the audio chain of both the transmitter and the receiver are also in wide use. If we understood them a bit better, their use might be virtually universal.

One of the things that confuses the filter issue so much is its apparent simplicity. Especially at low power levels, the power-supply filter is usually "designed" by simply picking out a choke that will carry the load current, putting as big a capacitor as we can afford on either side of it, and soldering the connections. What's more, this approach usually works.

Unfortunately, a similarly free-wheeling approach doesn't work so well when we get up into the voice-frequency range. And since at least two major design techniques are employed, with each of them subdivided into several smaller types of filter, most of us just tend to ignore the subject altogether.

This is usually a mistake. A low-pass filter designed to "cut off" at 3 kc will, in itself, make a significant improvement in signal-to-noise ratio if added to your receiver. It does this by passing all essential voice frequencies unaltered, yet knocking down the level of random-noise components above the cutoff frequency. Since our ears are most sensitive in the 3-to-6 kc region, the 6-to-15 db reduction in noise energy between 3 and 6 kc shows up as *more* than that amount of improvement in signal-to-noise.

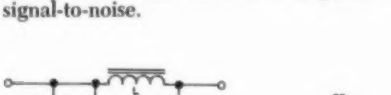

Fig. 1. Basic three element low pass filter.

In the SSB transmitter, the low-pass filter helps assure that the signal takes up no more spectrum space than necessary. While most of us assume a SSB rig has a 3-kc-wide signal, if it's modulated with input up to 10 kc and the exciter bandwidth is broad enough, the signal will be that same 10 kc wide.

In other types of phone transmitters, the low-pass filter keeps bandwidth at the minimum possible. With AM or DSB, it will hold it to 6 kc. With FM, bandwidth doesn't depend entirely on signal frequency but rather on amplitude, but the filter is a definite asset even here.

Back to the receiver, even if the *if* bandwidth is only 3 kc noise can still appear in the audio chain outside the 0-to-3 kc region; if the low-pass filter is near enough to the output stage, this noise will be eliminated and the S/N improvement will still be noticeable.

So you *should* have a 3 kc low-pass filter. You can buy them but they're expensive. So let's look at the ways and means of making them for ourselves.

As a starting point for this, let's look at the various design techniques. We may not end up actually using any of the things we find out along the way, but we will at least know what we're doing when we get to the soldering iron stage!

The two major design approaches (which apply to all filters, rather than just to low-pass af units) are known as the "image parameter method" and the "modern network theory" approach. Let's examine them both.

The "image parameter method" is the older of the two, and has been the standard filter design technique for more than 30 years. This approach starts out with the assumption that the filter is terminated at each end in an impedance which looks to the filter like another filter section. The closest analogy in most ham experience is the "flat" antenna feedline, which when terminated in the proper impedance looks from the other end as if it were infinitely long. Similarly, a properly-terminated image-parameter filter looks as if it contains an infinite number of sections.

To put it another way, the properly terminated antenna feedline also looks as if it's not there at all, since no matter how long or how short it is, the impedance looking into it remains the same as that of the antenna. And a properly terminated image-parameter filter will also appear not to be there, since its input impedance is the same as that terminating it.

In practice, the match can't be made exactly perfect. Over a reasonably narrow bandwidth, a purely resistive termination (such as a 500 ohm or a 1 megohm resistor) is a useful approximation to the proper terminating impedance, and tris is the way the filter is actually used.

While the mathematical derivations of all the design equations are exceptionally highbrow, the design equation itself for a low-pass filter such as that shown in **Fig. 1** is simple enough. The value of L (in henries) will be equal to twice R, divided by 6.28 times cutoff frequency in cycles per second. R is the impedance; if both ends of the filter are to see the same resistance value, R will be equal to this resistance value in ohms. If input and output terminations are to be different, R equals the square root of the *product* of these values (each expressed in ohms).

If both terminations are equal, C1 and C2 will both be equal and their value will be 1,000,000 divided by 6.28 times cutoff frequency in cps times R; the result is in microfarads.

If terminations are unequal, and C1 is to be on the low-resistance end of the filter, C1 will equal 1,000,000 over 6.28 x freq x R_{low}, while C2 will be similar except that R_{high} is used in the equation.

These are the standard "handbook" equations for low-pass filter design, and as mentioned previously have been in use for more than 30 years. A filter designed in this manner and terminated in its design impedances has a *theoretical* cutoff curve which is 3 db down at cutoff frequency, 6 db down at 1.15 times cutoff frequency, 10 db down at 1.4 times cutoff, and 20 db down at 2.14 times cutoff. From there, attenuation increases by 18 db every time the frequency is doubled.

With a 3 kc cutoff, such a filter would theoretically be 18 db down at 6 kc, and 36 db down at 12 kc. The −60 db point isn't reached, even theoretically, until the frequency reaches 30 kc.

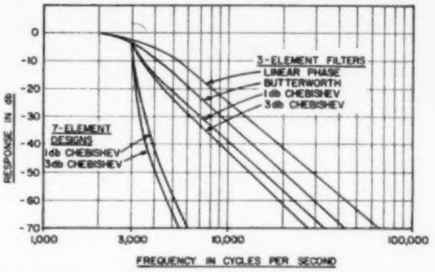

Fig. 2. Filter cutoff curves.

But note that these figures are all theoretical. The theory demands, however, that the filter be properly terminated—and we don't have a perfect termination. In fact, the image-parameter method of filter design demands terminating impedances for the resulting filters which are *physically impossible* to achieve. These terminations must be pure resistance at dc, yet with increasing frequency must reduce resistance (like a capacitor) to a complete short-circuit at the cutoff frequency, then increase resistance (like an inductor) as frequency continues to rise. They must still look like inductors at "infinite frequency" which is somewhere way above the laser in the spectrum!

Using pure resistances instead of these impossible impedances as terminations automatically makes our design incorrect, and as a result the theoretical cutoff curve is seldom approached in practice. The commercial acceptance of image-impedance designs over the years has been due in no small part to the extremely approximate requirements in most filtering applications. There's another reason, too, which we'll get back to much much later.

The other approach to filter design, the "modern network theory" design technique, came into being as engineers tried to overcome the basic limitation of the image-impedance approach. They set up "circuit equations" describing the performance they wanted, then applied network theory to solve these equations.

And when they did, they found that they had a few bonuses. The modern network theory technique let them specify not only the cutoff curve, but freed them from the requirement of specific terminating values as well. Either the input or output termination can be either a short circuit or an open, something not possible with image-parameter design, and the designer can specify at least one other filter characteristic in addition to the cutoff curve shape.

They had to pay a price for all this, though, and the price was an extremely complex design procedure. We don't pretend to comprehend all the mathematics involved in it. If you want to try, you can start with the *Journal of Mathematics and Physics*, volume 18, pages 257 to 353, where an article by S. Darlington titled "Synthesis of Reactance 4-Poles" appears. We haven't seen it and aren't eager to; the reference is taken from a footnote in another book.

In fact, this design technique barely got off the ground back in the old days before computers. But the high-speed calculating gadgets took the drudgery out of the mathematics, and let the theoreticians work out some charts. These charts, in turn, made it possible for a run-of-the-mill engineer with an M.S.E.E. to design a working filter using modern network theory.

That's still quite a ways from the Joe Ham level, but if you want to see the charts you can find *them in Reference Data for Radio Engineers, Fourth Edition,* pages 187 to 235. Earlier editions of this book don't have them.

After the design charts were published, a number of people became enthusiastic about the performance of these new filters, and the word began to get around. For the most part, the users didn't call them "modern network theory" filters. As we said before, the designer has the freedom to specify at least one other characteristic of the filter in addition to its cutoff curve, and the design equations for the filter depend somewhat on just what characteristic the designer decides he wants. The equations fall into general classes known to mathematicians by the names of scholars who first worked with the particular class of equations, and the filters became known by the name of the class into which their design equations fell.

So we started having Tchebychev filters (sometimes spelled Chebishev, Chebisheff, Tchebichef, or any other similar combination depending on how you prefer to transliterate Russian into English pronounciation!) and Butterworth filters showing up here and there.

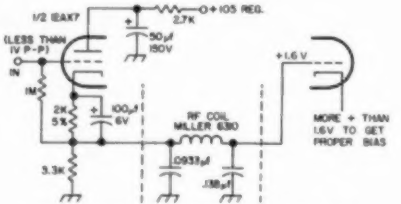

Fig. 3. Three element Chebishev filter for 3 kc with matching stage as designed in text.

In radar and certain kinds of computer work, there was a need for a filter which would transmit a *pulse* smoothly, and this called fo a special phase characteristic. The resulting filter was known as a "maximally linear phase" design. But *all* of these are modern network theory filters.

What do they do? Let's start by seeing what they all have in common. They can be designed for any desired value of terminating impedance, and one of the two terminations can be either an open or a short circuit. This means that we can design a filter to feed a vacuum tube grid circuit without having to waste any power in a terminating resistor (provided a dc grid return exists through the filter itself). They can be designed for almost any cutoff curve shape.

The Chebishev (that's the simplest spelling) filter provides the sharpest possible cutoff rate, at a small price. The price is "ripple" in the passband, which means that instead of having an absolutely flat response below the cutoff frequency, some frequencies below cutoff will be attenuated slightly as compared to others. However, this ripple can be reduced to a value as low as desired, by trading sharp cutoff for low ripple.

A Chebishev design using the same *electrical* circuit as that of **Fig. 1,** but having 3 db variation of response within the passband, will be 29 db down an octave above cutoff frequency. This is 11 db more attenuation than the theoretical curve of the image-parameter design, and what's more, this is the *practical* value as well as the theoretical one. With the image-parameter design, the theoretical value could never be reached.

If we reduce the passband ripple of this filter to 1 db, which for ham use would be flat so far as we could ever tell, it's still 27 db down an octave above cutoff, 9 db better than the older approach.

When the passband ripple of the Chebishev design is reduced to nothing at all, we find that we have (instead of a Chebishev equation) a "Butterworth response". As we would expect when trading cutoff slope for passband flatness, the cutoff isn't so sharp as that of the Chebishev. In fact, it's identical with the theoretical cutoff curve of the image-parameter design. This slope, however, is achievable whereas the theoretical design of the image-parameter filter isn't possible. We'll come back to this point later.

Slowest of all the modern-network-theory filters in cutoff rate is the maximally-linear-phase design. It is only 12 db down at twice the cutoff frequency, and doesn't reach its full cutoff rate until almost three times cutoff frequency is fed through it. At that point, it's 21½ db down, and attenuation increases from there at a rate of 18 db per octave.

Keep in mind that all the way through this we have been talking about the simple two-capacitor-one-inductor filter configuration of **Fig. 1.** Much sharper cutoff is obtainable by using additional reactive elements in the filter. A 7-pole Chebishev design, with four capacitors and three inductors, can be made to be 70 db down at just twice cutoff frequency, and this with only 1 db of ripple in the passband. Allowing 3 db of passband ripple would get us another 5 db of rejection at twice cutoff frequency, or a total of 75 db down. This is truly signal-slicing performance.

But as pointed out earlier the use of modern network theory filter design techniques allows us to improve our cutoff rate by some 10 db (approximately) in the important region just above the cutoff frequency with even the simple 3-element filter of **Fig. 1,** so let's go into the simple filter a bit more thoroughly.

Along about here, you're probably thinking "This is all very well, but if a graduate engineer has difficulty designing a filter by these methods then what are they wasting all that space for!" There's a reason, and we're about to unveil it. Before we do, take a look at **Fig. 2** which is a response curve showing the performance of various filter designs. This shows more clearly than words the differences between the types we've been talking about

Fig. 2 should complete the job of selling you on modern network theory designed filters, and prepare you for the idea of building one for yourself. Don't worry about the complexity of the design technique.

Here's why you don't need to worry: While the charts and equations are indeed formidable, the actual filter itself looks just like the ones in your receiver power supply, that shown in **Fig. 1.** So far as construction of the filter is concerned, the only difference between a 3 db ripple Chebishev and an old image-parameter design is in the parts values employed.

And in digging through all the design data, we stumbled across a technique which bypasses all the complexity and gives you the proper parts values almost instantly.

Interested? We'll warn you right here that there's a little arithmetic involved, but it's no more complicated than that you must use to determine row big a resistor must be to drop the voltage for your screen grids.

The starting point for our new design technique is a "table of coefficients" which appears as **Table 1.** As you can see, the fancy name refers only to a list of numbers. For any one type of filter design, there's one number which applies to C1, another to C2, and the third to L. The different values which these numbers have from filter type to filter type makes the difference in the design.

Or in other words, this table of coefficients includes everything that differs from filter to filter, for all the filter types listed.

Along with this, you'll need a reactance chart unless you want to calculate reactance values according to the classic formulas. Inductive reactance equals 6.28 times frequency in cps times inductance in henries, while capacitive reactance equals 1 over 6.28 times frequency in cps times capacitance in *farads* (to use mf. instead, put 1,000,000 above the line instead of 1).

Decide what impedance values you want for terminating the filter, and what you cutoff frequency is going to be (in case you haven't gathered, "cutoff frequency" is that frequency at which response drops 3 db). Use the reactance chart or the formulas to determine how many henries of inductance provide reactance equal to the terminating impedance, at cutoff frequency. For instance, if terminating impedance is to be 470 ohms and cutoff frequency is to be 3 kc, the inductance value corresponding to these values will be 25/1000 henry or 25 millihenries.

Similarly, determine the amount of capacitance required to provide reactance equal to the termination at cutoff frequency. For 470 ohms and 3 kc, the value is 0.113 μf.

Now go to the table of coefficients and pick out the type of filter you want. Multiply the inductance value you just determined by the "L" coefficient for your desired filter, and multiply the capacitance value by the "C1" coefficient to get the value of C1, and by the "C2" coefficient for the value of C2.

For example, to continue with our 470 ohm 3 kc design, let's see what values give us a 1-db Chebishev filter, if the output of the filter sees an open circuit (such as the grid of an amplifier tube with no shunt resistor). The "L" coefficient is 1.465, so we multiply our 25 millihenries by this value and find that we need a 36.7 mh inductor. Similarly, C1 must be 1.11 times 0.113 μf, or 0.1255 μf, and C2 is 1.64 times 0.113, or 0.1855 μf. The 470 ohm side of the filter is that on which C1 appears.

Now that we have our values, what can we do with them? None of them are over-the-counter items at our friendly radio store. We could go out and get an expensive variable in-

FILTER TYPE	Image Parameter	Linear Phase	Loaded Butterworth	Unloaded Butterworth	Loaded 1-db Chebishev	Unloaded 1-db Chebishev	Loaded 3-db Chebishev	Unloaded 3-db Chebishev
C1	1	0.338	1	0.50	2.21	1.11	3.36	1.68
C2	1	0.455	1	0.67	2.21	1.64	3.36	2.03
L	2	1.023	2	0.75	1.09	1.465	0.71	1.17

Table I—Coefficients for 3 element filters

ductor for L, then try to set it to the precise value. But we have a few other choices too.

For instance, good quality inductors are available in certain fixed values. The RTTY gang has been using 88 mh toroids for years; 44 mh toroids are available just as easily (the 88's actually have two 22 mh windings, in most cases).

High-inductance rf coils are also easily available. For example, J. W. Miller Co. lists a type 6308 25 mh coil, ±5%, for less than $1.50. They also have a 6310 50 mh unit for about the same price. Adjustable rf coils can also be purchased, if you have any means for setting the value to precisely what you want and knowing when you get there. Miller has a line in their 22A series (22A102RBI through 22A101RBI) which offers complete coverage from 5.3 mh to 125 mh., and the most expensive is priced just under $2. All of these coils have fairly good Q, which is an important point in modern-network-theory design.

When you need more inductance than these values, as you will if you design filters with impedances up in the 100K to 1 megohm region, then the simplest way to do it is to work backwards. Do a preliminary calculation as just described to find out the inductor value needed for your original set of specifications. Pick the closest value to this you can get, and reverse the entire procedure.

Going back to our example, let's re-work it to use that Miller 6310 50 mh coil just to show how this backward approach works. We know that the actual coil value is 1.465 times the reactance value, so for the actual coil to be 50 mh the intermediate reactance value for the coil must be 50/1.465 or 34.1 mh. This is the value with which we enter the reactance chart. The chart tells us that 34.1 mh will have 470 ohms of reactance at 2.2 kc, and that at 3 kc the reactance will be 641 ohms.

To use the 50 mh coil, we have a choice. We can move our cutoff frequency down to 2.2 kc, or we can increase our terminating impedance to 641 ohms. The preferred procedure usually is to increase the terminating impedance, because the cutoff frequency is one of the more important design characteristics. The terminating impedance usually is more a matter of choice and convenience.

With the impedance changed to 641 ohms, we recalculate the values for C1 and C2. They come out to be 0.0933 µf at C1 and 0.138 at C2; a 0.0091 µf 5% tolerance unit for C1 and a 0.14 uf 2% tolerance unit at C2 would probably be plenty close enough, but if you prefer to be a bit more precise you can build up the values by parallelling capacitors until you reach the exact figures.

To get the filter terminated properly in 641 ohms, now, may take a bit of doing. The starting point would be a 680 ohm 5% composition (not wirewound) resistor across the input. If the filter is to be fed from a 500 ohm source (transformer or line) an 11K ohm resistor in series between the source and the filter will both isolate the low source impedance from the filter, and transform the total terminating impedance to 643 ohms which is plenty close enough. However, the voltage-divider action of the 680 ohms and 11K in series will result in some 44 db of loss, so the idea doesn't work out too well. Note that this loss is in the terminating network *ahead* of the filter, not in the filter itself.

A cathode follower stage may be designed to have almost any desired output impedance, and this is probably the best way to match that 641 ohms. Output impedance at the cathode itself, in the cathode follower, is approximately equal to 1/gm where gm is the tube's transconductance. A 12AX7 operating at 100 volts from plate to cathode and −1 volt grid bias has a gm of 0.00125 mho, so output impedance would be 800 ohms. The cathode resistor (load resistor) is effectively in parallel with this, so by using a 3230 ohm cathode resistor we could get our 641 ohm impedance (800 ohms and 3230 ohms in parallel equal 641 ohms). Using a standard value 3300 ohm resistor would raise output impedance only 2 ohms and would be the way to do it.

Under these operating conditions, the plate current of the tube is ½ ma, which would give 1.65 volts across the resistor. Since we want only 1 volt bias, the load resistor and the bias resistor must be made separate. The 3300-ohm load resistor and a 2K, 5% bias resistor would be placed in series, with the 2K connected to the cathode and the 3300 to ground. The 2K would be bypassed with a high-value low-voltage capacitor (say 100 µf at 6 volts) and the grid resistor would be returned to the junction of the two resistors. Output would be taken from this same junction.

With such a hookup, the "gain" of the cathode follower would be approximately 0.8, which is less than 2 db loss in the matching. Although a few more parts and another tube are required to do it, the result is 42 db less matching loss.

The circuit for this particular matching arrangement is shown in **Fig. 3,** which also includes the filter (separated by a dashed line). Input impedance at the 12AX7 grid is about 10 megohms; it can be connected to almost any point without loading the source.

While we've gone into considerable detail for our sample 1 db Chebishev filter design, the same approach is true for any filter type listed in **Table I.** Simply pick your filter, using the curves in **Fig. 2** as a guide, and follow the procedure through, working backwards if necessary to use the parts you have available.

Quite a ways back there we mentioned that there was an additional reason why the image-parameter filter, though theoretically impossible, had been such a success through the years.

The sharp-eyed among you may have already noticed that the coefficients listed in **Table I** for the image-parameter filter values and for the *loaded* Butterworth-response filter are identical. This is no error. The two designs come up with identical parts values, though the approach by which they are achieved varies radically.

And the Butterworth is a modern-network-theory design, which does allow the theoretical performance to be achieved, while the image-parameter approach doesn't.

If all this seems to be somewhat confusing, don't be larmed. It's confusing to the engineers, too. The real difference is in the mathematical excursions underlying the design.

Perhaps this will be made a bit more clear by taking a couple of examples. An image-parameter filter can be designed (by its theory) to be placed between two unequal impedances, something like a quarter-wave antenna feedline is used to match the different impedances of line and load. For instance, a 500-ohm image-impedance filter could be terminated in 500 ohms at each end, or it could be placed between a 250 ohm source and a 10,000 ohm load. It would make no difference in the design of the filter; parts values would remain the same. But the loaded-Butterworth design which uses the identical parts values could be used *only* with 500 ohms in, and 500 ohms out. The values would be wrong, with any other set of terminations.

Since many image-parameter filters *are* used between equal impedances, where they are identical in performance to the Butterworth (or for that matter, *are* Butterworth filters), the results have naturally been good. But the theory on which they are based cannot explain the performance, as can the modern-network-theory approach.

This is why you don't find the image-parameter filter curve shown in **Fig. 2;** it's the same as the Butterworth, if the filter terminates in equal resistances. If not, the curve can't be drawn.

A bit should be said about some of the terms we've been tossing around. As we use it, a "loaded" filter is terminated in equal impedances at each end. An "unloaded" filter is terminated in its design impedance at the input, but output sees an open circuit such as a tube grid without shunt resistance. If some dc return is needed on the output, shunt resistors can be used provided that their value is at least 10 times (and preferably more) that of the filter's design impedance.

Notice that we haven't mentioned the M-derived filter; this is deliberate. Design and construction of a good M-derived filter is much more difficult than that of a sharp-cutoff modern-network-theory design, and the MNT design can give just as much attenuation without any of the accompanying problems.

Should you want or need these sharp-cutoff characteristics, you can use the data in **Table I** with the design technique already described to obtain values for 5, and 7 element MNT filters. Here's how: you design a 1 db ripple 3 element Chebishev, loaded, and then build *two* of them. The two are then stacked end-to-end (combining C1 of the second with C2 of the first) to form a 5 element filter. Similarly, three of them form a 7 element. With this approach, 7 element performance is achieved while retaining 3 element design simplicity. Keep in mind that the ripple, like the rejection, adds together, so that three 1 db ripple designs stacked up on end would have a total of 3 db passband ripple.

Which brings us to the end of the story about af low-pass filters. The rest is up to you; dig out those old filter chokes and the soldering iron, and give your rig another 10 to 20 db of effective gain!

. . . K5JKX

NEWS FROM THE INSTITUTE OF AMATEUR RADIO

Compiled by A. David Middelton W7ZC, Secretary

Challenging contest for young members

In keeping with the Institute's program for advancement in amateur radio through individual effort and achievement, IoAR announces its first Building-Writing Contest—open *only* to IoAR Members whose birthdate falls after July 15, 1946.

First Prize——a $25 Savings Bond, and publication at space rates in 73, for the best construction article for an original piece of AR equipment having at least *five* tubes or transistors.

Second Prize——a $15 Gift certificate, (good toward the purchase of any 73-advertised merchandise) and publication at space rates in 73 for the best construction article on an original piece of AR equipment having at least *three* tubes or transistors.

Third Prize——a $10 Gift certificate (good toward the purchase of any 73-advertised merchandise) and publication at space rates in 73, for the best construction article on an original piece of AR equipment having less than three tubes or transistors.

All design, construction, photographs and text material must describe only original equipment. Entries must not be copied from articles or equipment in any magazine or handbook. Kit construction or modifications, in any form, are not eligible.

All material submitted will be considered by competent IoAR-selected judges. Their decision will be final. Certification of contestant's birthdate may be required by the judges. IoAR membership will be checked by the IoAR Membership Dept. No correspondence will be conducted by IoAR HQ regarding this contest.

Non-winning entries will be returned only if accompanied by adequate first class postage.

To be eligible for this contest, entries must be receeived not later than July 15, 1966, at IoAR HQ, Springdale, Utah, 84767.

IoAR acclaims VHF-UHF performance

The Institute announces its new VHF-UHF certificate——"For Outstanding Performance on the VHF-UHF bands" based on certified two-way QSOs above 144 mc. This Certificate will be presented to any amateur for the first *ten* states worked on VHF-UHF, and certified. Later endorsements will be given for each additional *ten* states, worked and certified, in writing.

The Institute will present its "IoAR 50" trophy to the *first* amateur who makes two-way VHF-UHF contact with *all* fifty states, on frequencies above 144 mc. The recipient will also receive wide and appropriate recognition for this outstanding demonstration of VHF-UHF technical and operational skills.

IoAR, quick to recognize the importance of the new techniques and skills required in making DX contacts thru repeaters and satellites, *welcomes* inclusion of valid conformation of such contacts in all applications for both the IoAR 50 Award and the VHF-UHF certificates.

The IoAR certificate of merit

The Institute offers Certificates of Merit to any amateur meeting certain technical requirements, as follows:

"For Individual Technical Achievement" to those who hold a valid Extra Class license issued by FCC, or its foreign equivalent—or those who pass a comprehensive written technical examination prepared by IoAR and given under the direct supervision of IoAR Members at club, IoAR chapter, hamfest or convention sessions.

Arrangements must be made, by an IoAR Member, through HQ, for at least two persons (at one time) to take the examination at a specified club or chapter meeting.

Examinations will be conducted at conventions and hamfests when suitable arrangements are made, well in advance, between the sponsoring committee and the IoAR.

This IoAR examination consists of a number of multiple-choice questions covering the entire technical field of AR, including theory and practice. Completed test papers will be returned to IoAR HQ for grading. A passing grade of 75 will be required.

If this grade is not achieved, the applicant may again take the test after 12 months. No code test is included.

IoAR—Totally Dedicated to the Betterment and Preservation of Amateur Radio.

IoAR attends SAROC

The first Sahara Amateur Radio Operator's Convention, January 7-9th, sponsored solely by Hotel Sahara, Las Vegas, was a huge success.

IoAR's booth was staffed by W7ZC and his wife Charlet, ably assisted by IoAR members, WA6VTL, W7BIF and others. We met many friends of IoAR and made a lot of new ones (and members) through the medium of IoAR literature and plain talk about IoAR aims and accomplishments.

IoAR was the only amateur organization officially represented at SAROC. 73 was the only ham magazine having a display or representation. We were one of the twelve exhibitors.

SAROC was and will be an open convention. It was not "controlled" so everyone had a ball because there were no boring speeches.

There were excellent prizes, a registration of 339, plenty of ham spirit, exciting technical talks including one on space communication, plus fun and extra treats provided by the Fabulous Sahara! This was a convention to remember. Hotel Sahara has announced January 5-8, 1967 for their Second Annual SAROC.

Las Vegas coordinates AR and CB

Radio amateurs and CB'ers in Las Vegas, Nevada, are organizing a joint AR-CB emergency facility. WA7EMP, the prime-mover of this worthwhile effort, asked IoAR to seek information from groups in other localities who are working on similar projects. News on either positive or negative results would be welcomed by WA7EMP.

Note to new readers

If you are reading your first "News of the IoAR column, plase be advised that information of vital significance was contained in the January and February '66 issues of 73. If you are unable to obtain a copy, write IoAR HQ for a reprint, available until limited supply is exhausted.

Membership in IoAR

If you approve of this IoAR approach and are not a member we extend a hearty welcome for you to join us.

The IoAR story on tape

IoAR is preparing tapes (3¾ ips, monaural) to be made available to clubs.

The narrated stody of IoAR will be 15 to 20 minutes in length and will include details on the purpose and goals of the Institute, its membership and organizational structure, its awards and other informative IoAR data.

These tapes will be loaned to clubs, without charge. IoAR HQ will appreciate their prompt return after they have served their purpose in your group so that we may send them out to another club.

Important IoAR Addresses

For all correspondence except that regarding membership and supplies:

Institute of Amateur Radio
Springdale, Utah 84767

For membership correspondence and IoAR supplies:

Institute of Amateur Radio
Peterborough, N.H. 03458

The IoAR Story——on tape——will add a unique touch to your club meeting(

IoAR invites an officer of your club to make a written request to IoAR HQ for a tape;

Collector's item—The Oscar Story!

Last Spring, OSCAR 3 made radio history. The full story of the fabulous Oscar project is now told on a 1200 ft. 7.5 ips monaural tape thru the courtesy of K6LFH.

This historical narration and the "sounds of Oscar" is now available through Mrs. Marie Welsh, WA6VTM, for the incredibely low price of $1.25 postpaid; Get one of these tapes and learn about OSCAR, its problems, thrills and outstanding successes;

(WA6VTM is an active member of the Lockheed Amateur Radio Club and a Founding Member of IoAR.

INSTITUTE OF AMATEUR RADIO MEMBERSHIP APPLICATION

(Use separate sheet if desired)

Name .... Call ....

Address ....

City .... State .... Zip ....

....$5 enclosed for one year membership in IoAR.

....$7 enclosed for IoAR membership and one year of 73.

....I am a new member of IoAR.

....I am a Charter IoAR member and desire to have my membership continuous.

....This is a renewal of 73 but a New IoAR membership.

Please send check or money order (cash sent at sender's risk) to:

Institute of Amateur Radio, Inc.
Membership Department
Peterborough, N.H. 03458

Gus Browning W4BPD

Gus: Part 10

I am writing this chapter while I am in Iceland. Just how I ended up in Iceland, in a few words is this: I departed from Glascow, Scotland for the Faroes Islands, and, as usual for this part of the world, the weather was foggy, rainy and cold. We left about 10:30 AM and at 1:30 PM we were over the Faroes. The weather had gotten worse and we were informed that the DC-3 could not land at the Faroes and we were going to go on to Iceland and probably would come back to the Faroes the next day. This was 3 days ago!

Yesterday I went on a tour to see some of the sights around Reykjavik. It was a very short tour but I did see some of the hot springs around here. I saw many places where steam was coming up out of the ground. One of these geysers could be made to flare up by putting soap down into it. This one squirted up about 150 feet, steam and hot water mixed together—boy, what a smell; just like rotten eggs! I saw one place where they had taken one of these geysers and were piping the steam to Reykjavik, 15 miles away, where it is used to heat the houses. I suppose this is the world's cheapest city heat. Up in this area also were many hothouses where they grow tropical vegetables and fruits. I actually saw bananas and oranges being raised here in Iceland! There were such items as tomatoes, melons, cucumbers, lettuce, etc., growing in profusion.

Last week I was down at 4U1ITU in Geneva during their annual get-together. Stu-W2GHK met me there and plans for the future were discussed at length. We have some good plans—sure hope they work out. K2HLB put on a good cocktail party for the gang there. Many good speakers were on hand and some very interesting things were discussed. Bill Orr W6SAI held the attention of everyone with his talk on satellite communications. (A hint: you fellows had better start learning more about this business of communicating by satellites—it's the coming thing, and I think maybe one of these days there will be a DXCC by satellite QSO's.) I even gave my little speech on DXpeditioning. Sure did meet some FB people there and hope next year Peggy and I will be able to attend together.

Looking out my hotel room here in Reykjavik I notice that every building here seems to be almost brand new. Things are really booming here. Just a few minutes ago I asked for a cup of coffee here at the Saga Hotel where I am staying and found that it was about 52 cents. Coffee in the Waldorf-Astoria in NYC is not that much. Bring plenty of money if you ever come to this place, because if this is a sample of how things are in Iceland, it will cost you plenty! Now it's time to get back to my story.

I was telling you that I made the trip from Nairobi to Dar-es-Salaam by African bus. I was the only pale face on the entire trip, which, incidentally, was very cheap, costing only about $6.00. The trip takes two days and one night. Three drivers were "used up," and I mean used up. I have never been able to decide who it was worse on—the bus, the drivers, or the passengers. The drivers were kikues and the passengers were Masais. Now these Masais usually had very long, very wicked-looking spears along with them. The driver of the bus made the men put these spears in the front on the bus, beside the driver, while the Masai warriors sat in the back—separated from their weapons. I asked one of the drivers why he made them put their spears up front and he just said, "Well, you can never tell what these fellows might do!"

When I went up to the office that was selling the bus tickets I was asked if I wanted first or second class tickets. After thinking it over a few seconds I said first class (100% higher cost. I was then told by the fellow selling the tickets that I should buy second class and to hand the bus driver a few shillings when the bus got outside the city and he would let me come up in the first-class part of the bus. When it came time for the bus to depart I went along with the natives to the back section of the bus. The smells were a little on the strong side, I will have to admit. The bus driver saw me and told me to come up to the first-class section. I showed him my second class ticket. He said it was all right, that we could settle it later. So up to the front I went and I had the whole two front rows of seats all the way to Dar-es-Salaam.

This was a very informal type of bus ride. The driver would stop the bus for me any time I wanted him to, so that I could take pictures. When someone "had to go" they just yelled out and the bus driver stopped the bus and they just stepped outside the bus door. They are not bashful in the least. After leaving Nairobi in the distance, the bus started stopping to pick up and discharge passengers along the way. Many of the native women that got on the bus did not have on anything above their waists. When this first happened you of course observed their appearance—you just naturally observe things that are showing and flopping around. But after the first few hours you get accustomed to these sights and then you don't pay any attention to them any longer. Some W6 station told me that some of the bathing suits around San Francisco were being worn like this last summer. When I signaled the driver to stop, I headed for the bush and the bus driver said, "No, no, Bwana, lion in bush." Well from then on I "went native" like everyone else.

Along the way many wild animals were seen. Once three mean-looking elephants were in the road. The bus stopped and we waited until they got good and ready to QSY from the road. Another time a great big baboon jumped on the hood of the bus. The driver made everyone roll up their windows and he started blowing his horn, ring a loud bell, and slamming on his brakes, reversing the bus; but this baboon would hold on and would not be shaken off the bus. The driver said, "OK, you go to Dar-es-Salaam with us!" Away we went with the baboon on the hood of the bus. He stayed on for about 2 hours, and when we were meeting another bus he just jumped from our bus to the hood of the other, and I guess when he got back to his starting point, hopped off. A real professional hitch-hiker!

Monkeys? You talk about monkeys! One morning a little after sunrise we were going thru the jungle where the trees and bushes were very thick, when I heard the most ungodly amount of squealing and grunting. Here came the monkeys by the thousands. They were crossing the road, some hopping and jumping from limb to limb, small ones on their mothers' backs; big monkeys, small monkeys, monkeys of all colors, every one of them screaming and tearing across the road. The bus stopped and for well over five minutes the monkey parade streamed across the road. We saw many lions, mostly at night, a few leopard, and many hyenas, droves of zebras and many different kinds of antelope and deer. This was a fine trip and some day I would like to make it again if things cool off down here.

I was treated with respect and had no difficulty except once. The bus had stopped at a tea house for refreshments, and after I had my spot of tea (a Coke would have been much better) I went back to the bus and began watching all the Masai tribesmen. One of the old women of the tribe came up under my window and held out her hand for a "donation." The only thing I had was a sackful of hard boiled eggs. I handed her one and she looked at it quickly, then slammed it down on the ground and smashed it to bits. She then said to me in a very mean tone of voice, "Me Masai, no eat eggs, want shillings." This stirred up quite a commotion, so the bus driver herded the people together and we made a real quick QSY from there. You see, you might get in trouble even trying to give something to someone. We continued on our way and, when stopping time came, the bus driver would dump all the passengers out of the bus except me, drive me to one of the English tea rooms, drop me off, then go back and pick up the others and then come and pick me up. You know, I have been thinking, and I don't believe I ever did give that bus driver the few extra shillings I owe him for slipping me into the first-class section.

We passed right near Mount Killimanjaro and it's a real surprise to see a real big mountain covered with ice and snow in the middle of Africa. For any of you chicken-hearted fellows, I strongly suggest you make this trip because it will toughen you up. It is not exactly like a Greyhound trip from South Carolina to Washington.

Upon arriving at Dar-es-Salaam there was a customs inspection and VQ3PBD (Peter Dobbs) met me there and all he said was "this is a friend of mine" and that was all there was to it. Peter took me out to his house on the outskirts of the city where I met his wife and little family. I got on the air at VQ3PBD and had some very fine contacts with a few of the boys in the States. After a few days with Peter, time came for me to leave for Zanzibar.

The flight from Dar to Zanzibar was less than 20 minutes long, and when I arrived there a customs fellow came over to me, and all I told him was "I am a friend of Peter

Dobbs." It was open sesame and there was no inspection at all. You see, Peter was the head of the Tanganyikan customs and evidently well known even in Zanzibar. I bet things are not that easy over there these days. We went down to the Director of Radio and were issued our licenses very quickly. I got VQ1A and the VQ3 chap from Dar-es-Salaam got VQ1B and we went to a small hotel, put up our antennas and we were on the air in just a matter of minutes. Conditions were reasonably good, even 10 meters opened up a few times to the USA. Some 4 or 5 thousand QSO's were made in a little over a week's operation. VQ1B had only one weekend to spend there, so he departed and I stayed for another week. I walked all over the city, and what a puzzle it was with all those very small zig-zag streets. I visited many small shops and bazaars and picked up a few curios at very good prices. I also visited many of the workshops making ivory carvings, some taking months to make those long elephant bridges that are made from a whole elephant tusk. Some of them were 5 or 6 feet long, with a whole row of elephants in a line, each one holding the tail of the elephant in front. These were out of my pocketbook range, but it was very interesting seeing the very simple tools they used—only a small hammer, a few small chisels, an old beat-up file or two, an old hacksaw blade and a few pieces of sandpaper. It's a very slow process and requires a steady hand. One slip and the carving is ruined, but these fellows did not slip. Many Arabian dhows were seen at anchor being loaded to carry cargo back to Muscat, Aden, Saudi Arabia, etc. These dhows, I was told, would stay there until the southeast monsoon started and then go downwind all the way up the coast of East Africa to their destinations. They are very tough-looking ships and their crews looked the same. Zanzibar was one of the most interesting places I have been to. When it came time to leave, to the airport I went and back to Dar-es-Salaam where Peter Dobbs again met me. I spent the night with him and his family and early the next morning I was away on that African bus for Nairobi. I must have been a glutton for punishment. The return trip was about the same as the trip down, but more so. The same assortment of wild animals here and there and the same assortment of people on the bus, and even the same smell. Wouldn't it be nice to go down there along with Wayne Green, Al Hix, Howard Wolfe, and Enos W4VPD and go on a DXpedition on top of Mount Killimanjaro?

Back in Nairobi I spent a few days with George, who was then VQ4AQ, later 5Z4QT and ZS6? Everything was repacked, some things discarded, and I was away to Mogadiscio, Somilia, and the usual battle with customs began. They would not let me take the radio gear away from customs. Away I went to their Director of Telecommunications telling him all about my study of radio propagation, and I ended up with a note for their customs telling them to release my equipment, that he would be responsible for it departing with me when I left. I got my gear very quickly then!

I went to the highest hotel in town (sort of a small version of the Waldorf) and explained to the manager that I had to put my little aerial on the roof. All I had then were horizontal antennas which require poles. I had to find some poles, which I did and back to the hotel I came with them and right thru their real fancy lobby I barged. These poles were about 40 feet high. I bought 4 of them from a sort of lumber yard. Needless to say there was a lot of confusion and excitement when we came through that lobby dragging our poles across their wall to wall carpet, almost knocking down a big crystal chandelier. Luckily the hotel manager could not speak much English so we just kept on going while he was trying to tell us something. In all the confusion we got the poles thru the lounge and then up to the roof which required snaking them around the elevator shaft up about 7 floors.

All this time I had a young fellow with me who acted as my interpreter, a good investment at a lot of places. I was assigned the call sign of 6O1AA and the QTH was very FB, good signal reports. I tell you fellows when you want some good solid comfort get yourselves a real nice air conditioned hotel like this and all you do is sleep and operate. It makes a big difference in your performance on the air. This is the kind of DXpediting I like, but try finding such things in the really out of the way places. All I can say about the 6O1AA operation was it was a real lark all the way. Meals in this hotel were about $3.00 each, but with the assistance of my interpreter I got the same meal at a small restaurant for about 75 cents. The day came to depart and I was faced with the problem of those poles on the roof. My solution was very easy—we just threw them from the roof and let them stay where they landed—plenty of people wanted them for stove wood. I was afraid the hotel manager would have heart failure if we came back thru his lobby. Sometimes it is easier to get a license to operate than it is to get permision to put an antenna on the roof. On later DXpeditions, thanks to Hy-Gain and their 14AVS and 14AVQ verti-

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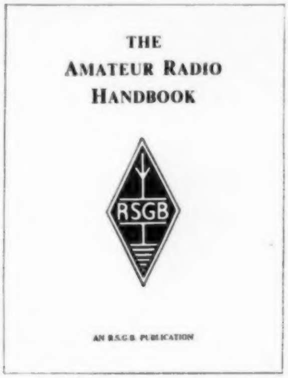

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cals, this problem has been pretty well solved and you have 4 bands in one place with a good SWR, and don't kid yourself, they do work! They made up one for me in shorter sections and it all goes in a small canvas bag 3 feet long and weighs about 6 pounds. It's and FB antenna for DXpeditions and goes up in just a few minutes. I use only 2 ground plane wires cut for each band I intend to use and the SWR is less than 1:1.5 on each band, which is pretty doggoned good for such a simple thing to install.

My next target was Djibouti. To get there from Mogadiscio required first going to Aden and getting on another plane and flying back to Djibouti. It always happens that you have to spend from one to three days in Aden to get a connection for this flight. This gives you a chance to see some of Aden and area around it. This is a very desolate part of the world, very little plant life, desolate-looking black mountains with no trees or anything else growing on them. To me they sort of look like, I suppose, the moon may look when someone gets there to inspect it.

There is *always* a big argument with taxi drivers in Aden, even when you have a definite understanding about the charges. They are out to wring the last shilling out of you

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and brother if you are not really a good man defending yourself you will get "took" every time. They don't use meters on the taxis, so it's just you and him. The best way I found to deal with them was to ask the hotel receptionist what the proper charges were for a certain trip and when the taxi got there you handed him that amount plus a tip and just walk away from him and let him holler that you owed him more. I have never heard of one of them calling the police yet.

If you want to buy something in Aden their prices are fine on everything since it's a free port. Be sure to do your buying on the days when no big passengerships are in port because on those days they go up about 20 to 25% and you cannot talk them into cutting below this figure. You can find anything in the world there: Japanse transistor radios, tape recorders, cameras galore, Kodak film, perfume, jewelry, clothing, shoes, and any kind of luggage you want. All I can say is Aden is quite a place, hot as blazes, Arabs all over the place, camels right in the middle of the city pulling their carts, Yemenis walking down the street with their loaded rifles and fancy native dress.

I met some of the RAF boys out at Steamer Point and even operated their club station for a few hours. I found that none of the new fancy buildings had an elevator that operated. Oh yes, they had elevators, nice looking, fancy ones, but they just did not work! Some Otis Elevator salesman should be able to really clean up there selling elevators that work.

After staying there a few days my fingers were itching to get on a key and I was glad to depart. The flight left about 10 AM—oh yes, you are wondering about the Aden customs—ha ha—there is nothing to them at all, they ask you if you have anything to declare, you say NO and that's it! They have never looked in any of my suitcases and I have now (this is Nov. 1965) been thru there about 10 times. I wish all customs were like Aden—it would be a real pleasure traveling around.

When you step off the plane in Djibouti you know you are in a spot that really has hot weather, and I mean HOT. It is located on the edge of a desert you can see it all around you and feel it in the air that surrounds you. After the usual checking of your passport and the examination of your health card then the next business at hand is your baggage examination. Now you TRY explaining to a fellow in English just why you are there with all that radio gear, and he only understands French. I had decided that when my equipment was stopped in customs anywhere along the way that I would just let them have it and keep it until I got a license and then maybe with this they would release it to me. This is what I tried to do there. They said they had no place there to keep it. It ended up with my taking it along with me to my hotel room. That's exactly what I wanted and this suited me fine.

There was only one hotel in Djibouti at that time that was air-conditioned, so that's where I checked in. The air-conditioner was one of those cold ones and it really did a bang-up job. I tramped to the local post office (there is only one there) and located the head man. I told him I wanted a Radio Amateur License. I gave the filled-in form to him and he told me to return the next morning. Back to my hotel I went with the sweat pouring off me. Even my shoes were soggy. I was told the temperature was 115 degrees. I hung around the hotel all day drinking Cokes, got out and did a little walking around, took a few photos. Rundy OD5CT was to meet me later on and do some operating since he was coming to that part of the world on business. That darn air-conditioner made my room like an ice box. I found that it was wired directly into the circuit and there was no way to turn it off. The windows were nailed down and I could not open them. So I put on the heaviest clothing I had, even a nice heavy sweater. The next morning I went to the post office where I got the license with the strange call of FL9. Then I had to go to the Governor's mansion for his signature before the license would be valid and then back to the post office to pay for the license (somethinglike $17.50!) When this was all taken care of back to the hotel I went, after buying two nice long bamboo poles for my antenna. With my previous experience I found it best not to mention the word radio when checking into a hotel, but simply to locate two of best bellboys and get them to help you with the antenna when you were ready. The poles were pulled up on the roof from the side of the hotel. There was a lot of scampering on that corrugated tin roof—and I mean it was a hot roof! We got a basin full of water to stick our feet in to keep them somewhat cool. The 40 meter dipole ended up across the street on top of a Chinese laundry. The family lived on the top floor which meant we had to go thru their apartment to get to the roof. I noticed that their apartment was really fixed up very elegantly, with tapestry all over the place and even a small built-in Bhudda worship temple. They insisted I have tea with them, which I did. It was that nice smooth green type served with small and very sweet cookies. I made friends with the family and had tea with them almost every day after that. The man of the house could speak a little English, which helped a lot.

I had been told to notify the police when I was ready to operate and that they would have to inspect my station before I could operate. This I did. They came around 5 PM, looked things over and asked a few question, filled in a little form, had me sign it, and left, but told me to remember that the maximum power allowed was 100 watts. I did not question them if this was input or output. I just assumed it was output and I further assumed that this 100 watts was the difference between the reflected power and the forward power. I was using a rig that was capable of 175 watts output so I didn't worry about this part at all. I could see that the fellows I was talking to didn't have the faintest idea what it was all about. Conditions were fine, the band stayed open practically all night. My operating habits ended up something like this. I would start my operation each morning at about 5 AM and I would operate till the band leveled off at about 10 AM then hit the sack, setting my alarm for 3 PM. I got up then and stuck with the boys until the band went flat about 2 AM. Very little time was lost sleeping there. I forget the exact number of QSOs I had from Djibouti but I think it was some thing over 5000 during the 8 days or so I was there.

After I had been operating there about 5 days Good Ole Rundy OD5CT finally got there and was assigned the call sign of FL8ZA so I let him take over operations for a while. Now Rundy is a fine operator so don't misunderstand me, but Rundy at that time liked to operate transceive—right in the USA portion of the band. Well you know how the eager beavers are on a deal like this. I tried to explain to Rundy what was happening back in the States. This was on a Sunday afternoon back there so you all know how it is. To work the States and to do it properly the first thing to do, in my opinion, is to stay out of the "W" portion of the band—never get in there or you will be murdered in about 5 minutes. I think the best way is to take on all comers regardless of who they are or what country they are in and to use a non-directional antenna (vertical) (then you can't be accused of pointing your antenna at the USA all the time by the Europeans or VK's). Work them all until you have the pile up whittled down to something you can handle. Tail-ending—sure I love it when it's done right, quick short ones—only *after* the report has been sent. The longest conversation I want on SSB is, "Hello Gus, Q5-S9 W5?? break". If I want to rag chew, let *me* start it. Don't send my call boys (I know it) just your call sign and then a BK.

Away we went back to Aden. Rundy and I had to stay there 2 days to catch a flight from Aden to Bahrein. If you want to see how the moon will look to the first fellows who get there, just fly from Aden to Bahrein. You will see some of the most desolate scenery below—those big black mountains with no trees, and the valleys look as if they are filled with black dust—and I have heard that's exactly what it is. Rundy said that if the plane ever had motor failure over that part of the world he would cut his throat just before the plane hit the ground. He said even if the fall did not kill you the dust would strangle you anyhow, and if this did not happen then the Bedouins would get you. So either way your number was up. I am glad to say the old DC-3 made it all OK and neither Rundy nor I had to use our knives.

Let me tell you about those countries on the Persian Gulf from Kuwait to the Muscat. To go to these places you have to have a police permit from each and every one as well as a sponsor in each place. This sponsor must be "in" with the local authorities—luckily Rundy had the connections and had this arranged beforehand for us, or we would never have been allowed to even leave Aden for the Persian Gulf countries. Getting licenses there is very simple—you just produce your W license and they hand you licenses for all four of the MP4 spots. We met the Big Bad Wolfe—MP4BBW Ein Cable out at his house and saw where all that signal comes from. The equipment was set up at the "Speed Bird Hotel" and I was on the air signing MP4BDE and had quite a ball for a few days. Bahrein is very prosperous looking place, plenty of big cars, the stores seemed to be doing a good business. There were a number of big oil tankers out at the docks filling up. You could see this was an oil town. Everyone seemed to speak English so there were no language troubles at all. You know it's a funny thing but after being in these places like Djibouti, Aden, Bahrein etc,., with all their hot weather after a while you begin not to notice it's so hot. I guess they know it's hot and that it will stay hot so that they just ignore it completely.

Time came for use to leave and we got all set to QSY to MP4Q. We were heading up the Persian Gulf and to me this was going to be interesting. Well this is it for this month boys, see you all next month. . . . . Gus

Ralph Hanna W8QUR

Power Supplies

The trend in power supplies over the past several years cannot go unnoticed. The most interesting thing is the great reduction in size. What has brought about this big change? The first thing is the silicon diode or rectifier. This device has many advantages over the tube type rectifier. The small size is very important. This feature allows for less chassis space being taken up by the power supply. The high current handling ability, of course, is important too; an ordinary one will carry ¾ of an amp. These little rascals don't get very hot either. This is real nice when used in a receiver since the vacuum tube rectifier generates a terrific amount of heat. Here now is one of the big items in reducing the size of a power transformer, the elimination of the rectifier filament winding. The elimination of this item will give a considerable size reduction in the windings on the transformer as well as the core size.

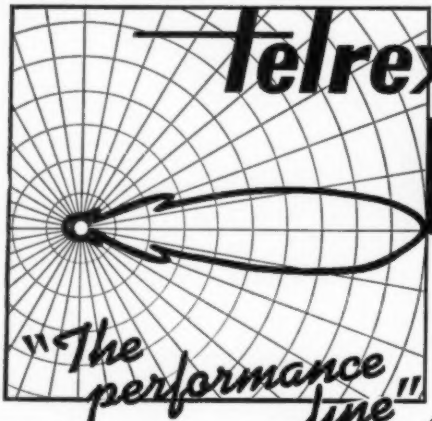
Since silicon rectifiers are small in size and low in cost, it naturally follows that many manufacturers would go to voltage doubling, tripling and even quadrupling. At first it would not appear that this would be any advantage because the wire size would have to be increased for the same watts output. The saving comes in the fact that there are less turns, therefore less insulation. Then because of the lower voltage, the insulation can be much thinner.

If you are building up a power supply, take a look at old TV transformers. These jobs are real good and one rated at say 200 MA at 400 volts can be made to run an amateur transmitter at 200 to 300 MA at 800 volts by bridge rectification. This is easy now because you don't need three filament transformers. Someone is going to ask how the 800 volts at 200 MA is accomplished from a transformer rated at 400 volts and 200 MA. The secret is the fact that we do not use the rectifier filament winding so do not have that heat loss and that the usual amateur service is intermittent and the average power is much lower than the 160 watts. It is not recommended that the full power be consumed, like when tuning up, for more than 5 minutes.

Many of the radio stores have bargain rectifiers rated at 400 volts PIV. This means that you should not run more than about 280 volts AC on this unit. A 600 PIV or 800 PIV rectifier gets quite expensive, so the best bet is to double up and use two of the 400 PIV units in series to get 800 PIV and about 560 AC volts.

When using the rectifiers in series, it is recommended that parallel resistors be connected across the individual rectifiers to divide the voltage equally across each rectifier. In some cases capacitors are also recommended. In spite of these recommendations, many commercial units use the diodes in series without either resistors or capacitors.

. . . W8QUR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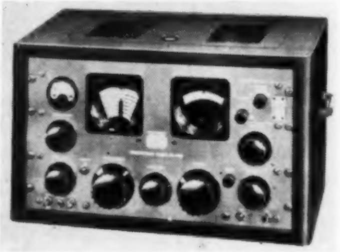


For the first time we are able to offer a superb receiver at a modest price. We agree these receivers are not cheap, however, they are one of the best available and, are in **excellent condition.** We have only a few to sell and they are all **unconditionally guaranteed.** Here are some of the Technical Spec.

Frequency range: 0.54 to 54 mc in 6 bands
Audio Power Output: 2.0 Watts @ 600 ohms
Power Required: 95 to 260V, 50-60 cycles at 130 Watts
Tubes: 20
Mechanical: Rack mounting 19"W X 10½H X 16"D
Weight: 66 lbs.

Performance:

Sensitivity: 2.3 microvolts or better on all bands for 8 + N to N ratio of 10 db. (we checked one on 51 mc and its sensitivity was 1 microvolt).

Image Rejection: better than 74 db on all bands.
I.F. Rejection Ratio: at 600 OKC is 2700 to 1.
A.V.C. Action: output will hold within 12db when input is increased from 2 to 200,000 microvolts.

Frequency Control: Continuous tuning plus a separate crystal control oscillator in which 6 crystals can be used for spot frequency operation.

Shpt. Wt. 100# w/o cabinet
PRICE: SP 600 JX $349.95

POWER TESTED SILICON RECTIFIER UNITS

(1 amp. @ 1 ma. max. leakage)

50-200 PIV	Price:	.06 ea.
200-400 "	"	.14 "
400-600 "	"	.24 "
600-800 "	"	.36 "
800 or better	"	.44 "
1000 PIV	"	.54 "

POWER TESTED SILICON RECTIFIER UNITS

(All 5 amps.)

290-400 V	Price:	.30 ea.
400-600 V	"	.40 "
700 V	"	.69 "
800 V	"	.84 "
1000 V	"	1.99 "

POWER TESTED SILICON RECTIFIER UNITS

(All 35 amps.)

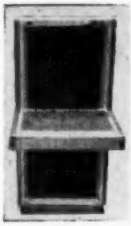
50 V	Price:	.84 ea.
100 V	"	.92 "
200 V	"	1.94 "
300 V	"	2.68 "
400 V	"	2.99 "
500 V	"	3.28 "
600 V	"	4.08 "

APX 6 TRANSPONDERS

LESS TUBES
PRICE: $9.95

EXCELLENT CONDITION
shpt. wt. 50#

SPECIAL DELUXE EMCOR RACKS



STANDARD 19" PANEL

Overall Height	51"
Panel space	43¾"
Overall depth	22"
Overall width	23½"

CASTERS and 18" x 23" table included with full rear door.
PRICE: $29.95 shpt. wt. 200#

DESK TYPE RACK

Standard 19" Panel

Overall Height	13¼"
Overall Depth	19"
Overall Width	21½"
Panel Space	8¾"

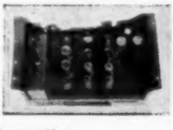
PRICE: $14.95 shpt. wt. 35#

DOUBLE RACK for 19" PANELS

Overall width	44½"
Overall depth	22½"
Overall height	33⅛"
Panel Space	28"

PRICE: $24.95 shpt. wt. 175#

REGULATED POWER SUPPLY



Wickes Model PS—3
Power Input 105-125V, 50-60 cps. 370 W. Regulated D.C. output (adjustable) 270-300V. Max. output current—400 ma regulation: 100 to 400 ma—less than 0.5 V. AC ripple, peak to peak—less than 0.015V. Output impedance — less than 0.7 ohms. Overall Dimensions 19" x 10½"H x 12⅝"D. Recessed 19" rack mounting.
PRICE: $29.95 .... shpt. wt. 85# S-6425

TUBULAR HIGH CAP. ELECTROLYTICS

CAP.	W.V.D.C.	PRICE	2 for	CAT.
20,000	MFD 25V	.95	1.50	S-7120
25,000	MFD 25V	1.25	2.00	7121
20,000	MFD 30V	1.25	2.00	7122
40,000	MFD 10V	.95	1.50	7123
40,000	MFD 30V	1.75	3.00	7124

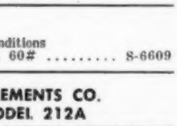
APR-1 TUNING UNIT

30 to 90 mc. TN-1B Easy converted to 6 meters. EXCELLENT CONDITION
PRICE: $24.95 .... shpt. wt. 26# S-7131

SUPER PRO POWER SUPPLY

Rack Mounted Excellent conditions
PRICE: $19.95 .... shpt. wt. 60# S-6609

ELECTRONIC MEASUREMENTS CO.
POWER SUPPLY MODEL 212A



Input: 125 V @ 60 cy.
Output: 0-100VDC @ 0-100 ma. ideal for transistor work.
Price: with covers $39.95
less covers 34.50
Shipping weight = 17#

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CINCINNATI, OHIO 45217
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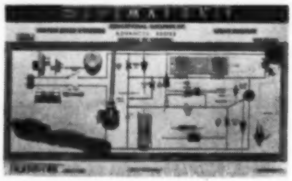
NEW PRODUCTS

Hallicrafters HT-46

The new Hallicrafters HT-46 five band transmitter provides 180 watts PEP input on SSB and 150 watts on CW. It's designed as a companion to the SX-146 receiver and may be used independently or interconnected with the SX-146 for transceiver operation. The all-new HT-46 covers the five HF ham bands in 500 kc steps and the signal path is single conversion using a 9 mc crystal filter. The built-in power supply is solid state and unwanted sideband and carrier suppression are better than 50 db. Ham price is $349.95 and the accessory VOX adapter is $37.85. You can get complete specs from Bernard Golbus at the Hallicrafters Co., 5th and Kostner Avenues, Chicago, Illinois 60624.



Trans-Tek

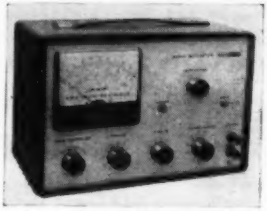
Trans-Tek is making some very inexpensive kits that will interest all hams for themselves and for youngsters with an interest in electronics. Each kit is clearly and attractively packed and uses modern solid-state components. The kits are: Metronome, $2.25; Code Practice Oscillator, $1.79; Hi-Lo Switch for lights and small motors, $1.79; Hi Lo Switch for larger motors, up to 500 watts, $2.49; 6-12 Volt Regulated Power Supply, $5.75; Intercom Amplifier, $5.95; Ultra Hi Gain Amplifier, $5.95; Variable AC control, $7.50. You can get more information from Trans-Tek, Garwood, N.J.

Handy Dandys

Any ham who has puzzled over a good, inexpensive way to mount the ubiquitous baby food jar full of parts will be very thankful to Wickliffe Industries. They're making a very inexpensive gadget that mounts on pegboard to hold your jars. It's called the Handy Dandy. Everyone seems to have plenty of the jars or can get them easily, so this may be the solution to your problem of storing and separating small parts. Price is very low. A sample of 12 is $1, 3 dozen are $2.50, 6 dozen are $4 and 500 are $25. Wickliffe Industries, Wickliffe, Ohio.

New-Tronics Super Hustlers

New-Tronics' new Super Hustler line of high frequency antenna resonators can handle the legal limit on SSB. They're designed for wideband characteristics and each of the unique coils is wound with wires containing 413 individual conductors insulated from each other. Impedance is 52 ohms at resonance without matching devices or line pruning and there is minimum frequency drift from heat. The Super Hustlers are designed for use with standard MO-1 and MO-2 masts and accessories are available. Jim Taylor, Newtronics, 3455 Vega Avenue, Cleveland, Ohio 44113, can give you more information.



Eico Audio Generator

Eico Audio Generator

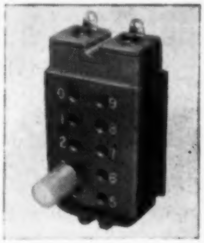
Eico's just introduced a new low distortion, wide range, high output audio generator that provides switch selection on any frequency from 1 cps to 110 cps by cycles. Frequency accuracy is 5%. The output has less than 0.1% distortion from 20 cycles to 20 kc and is metered with a large meter. Price on the Eico 378 is $49.95 in kit form or $69.95 wired. Get more information from your local Eico distributor or from Eico, 131-01 39th Avenue, Flushing, N.Y. 11352.

Panel Signs Transfers

The Radio Constructor, an English popular radio magazine, sells some panel signs similar to decals that will interest many of our readers. There are four sets: 3, White wording; 4, Black wording; 5, dials with clear backgrounds; 6, dials with black backgrounds. The dials can easily be calibrated, too. Price is a reasonable 75¢ apiece, or all four for $2.75. Best way to pay is an international money order. Data Publications, 57 Maida Vale, London W9, England.

Squires-Sanders FM Receiver

The new S-S FM Alert emergency receiver features two crystal controlled channels as well as variable tuning. It comes in two models: 152 for 152-175 mc, and 30 for 30-50 mc. The FM Alert offers excellent performance, convenient operation and versatility. Squelch is provided for easy monitoring. Price is only $89.95, with a separate matching speaker available for $9.95. You can get more information from Squires-Sanders, Martinsville Road/ Liberty Corner, Millington, N.J. 07946.

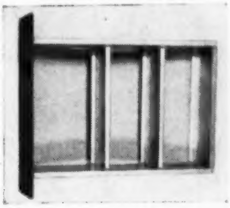


Clarostat Decade Boxes

Hams who experiment like to have quality decade boxes to use, but most of the ones available are pretty expensive. Clarostat has just introduced a series of new decades they call "Claro-Dec's" in the range of resistances from .1-.9 to 100 k 900 k. Each one costs only $3.95. For a brochure on the Claro-Dec's, write to Clarostat, Dover, N.H.

EZ Mobile Antenna Mount

The EZ Mobile Antenna Mount is a very clever, inexpensive way to mount your mobile antenna without poking holes in your car. EZ Mount says it will support any antenna on the market at any speed. The mount is made of double chrome coated stamped 14 gauge steel and mounts quickly on your trunk lid for better radiation characteristics than you get with bumper mounts. There are three models: C-375 for antennas requiring ⅜" holes, C-750 for ¾" and C-103 for ball mount antennas. Price is $8.95 postpaid. Mounts or more information are available from EZ Mobile Antenna Mount, P.O. Box 277, Algonac, Michigan.



Devices

A new 73 advertiser, Devices, offers a simple, neat, easy-to-use method for constructing electronic equipment. They call it the unit Chassis. The basic Unit Chassis consists of a half rack panel 3½" high, and three 3"x6" subchassis. When these four items are assembled in the Unit Chassis, any one may be removed without disturbing the assembly. You have to try one to appreciate its convenience and time-saving. Cost is $5 from Devices, Box 136, Bronx, N.Y. 10463.

NEW BOOKS

Pulse Electronics

Not all that's interesting in electronics is to be found in the ham manuals. They tend to lack necessary detail, and don't give enough emphasis to transistor operation and circuits. Such shortcomings can be made up by working on a good book, and Littauer's *Pulse Electronics* from McGraw-Hill, 1965, is recommended.

This is a bright orange and white volume, full of straight-forward information valuable to users of modern electronics. It was written for research workers who need to be able to design useful circuits without spending time in electrical engineering courses. Its direct treatment will meet the needs of the advanced amateur beginning to detect some major gaps in his understanding of electronics.

An early part of the book describes the operation of transistors and vacuum tubes. This is followed by a section on choosing operating conditions. A later chapter will update the reader exposed only to cathode biasing. Constant current, feed-back, fixed and other types of biasing are discussed, along with views on drifts and aging effects.

Four basic kinds of circuit feedback are considered. Bet you never heard of three of them! Still another section describes methods for taming feedback circuits, which, in case you lack the experience, sometimes tend to take off at high frequencies. And there are several pages which will interest those with filter problems.

So it goes, through 530 pages. This book is not easy, but is probably a dark horse in the amateur literature market because of its treatment of modern electronics. Find a copy and see for yourself!

. . . James Ashe W2DXH

TI Communications Handbook

Readers who are seriously interested in improving their knowledge of modern semiconductor communications will want to get a set of the Texas Instruments staff-written *Communications Handbook*. It comes in two paperbound parts. Each costs $2 or you can get the set for $3.50. The books go into detail (including mathematical) on all applications of transistors and other semiconductors in communications. Practical details are also given. The book is available from TI distributors (including Allied Radio) or Technical Publications, TI, P.O. Box 5012, Dallas, Texas.

Transistor Circuits

Two books by Allan Lytel put out by Sams should be of interest to hams who like to experiment with semiconductors: The *Transistor Circuit Manual* ($4.95) and the *Handbook of Transistor Circuits* ($4.95). Each gives the circuit for many useful and interesting semiconductor devices. For instance, the first one includes chapters on basic semiconductors, switching and logic, counters, flip-flops, power control, timers, indicators, photoelectrics, controls, transistor power converters, audio amplifiers, rf and *if* circuits, transistor and diode oscillators, power supplies and regulators, radio and TV circuits, AM receivers, and special circuits. The second book has many similar chapters. Each schematic gives practical values. Either can be bought from your local distributor or from Howard Sams, Indianapolis, Indiana.

RCA Receiving Tube Manual

If you think that tubes are dead, you haven't seen the new 576 page RCA tube manual. It sells for only $1.25, a fantastic value, and gives you page after page of useful information: tube theory, applications, installation, CRT dope, VR tube information, testing of tubes, amplifier data, outlines, circuits and, of course, extensive information on all RCA receiving tubes. Pick up a copy at your distributor or from Commercial Engineering, RCA, Harrison, N.J.

RCA SCR Experimenters Manual

Silicon controlled rectifiers (SCR's) are very useful semiconductors that are much used in switching, rectifying and control circuits. Among other applications familiar to hams, they are used in variable speed electric drills and make it possible to slow the motors down with little loss of power. RCA has come up with a fairly inexpensive kit of semiconductors for SCR experimenting and an excellent manual to go with it, the *RCA Silicon Controlled Rectifier Experimenter's Manual.* The book gives instructions that are easy to understand and use in making a lamp dimmer, motor speed control, electronic timer, time delay, flasher, battery charger, model train or car speed control, light operated switch, heat controlled switch, overload switch and electronic synchronous switch. You can have a lot of fun with this book. It's only 95¢ from your distributor or RCA Commercial Engineering, Harrison, N.J.

LIBERTY ELECTRONICS WANTS TO BUY FOR CASH

Electron tubes and semiconductors

Most any type or quantity
Receiving, transmitting, special purpose, magnetrons, klystrons
We will make you an immediate offer in cash.

Special sale

HP-200BR audio oscillator $65

Surplus communication and test equipment

AN/GRC-3, 4, 5, 6, 7, 8, 10, 19, 26, 27, 46, VRC-12
AN/PRC-8, 9, 10, 25
Test equipment with ARM, SG, URM, UPM, USM, and TS prefixes
Communications: AN/TRC-1, 24, 35, 36
Receivers: AN/APR-9, 13, 14, R-388A, R-274, R-390A, R-391, etc.
Indicators: ID-250, 251, 387, 257A, etc.
Aircraft: AN/ARC-27, 34, 38, 44, 52, 55, 57, 73, 84
AN/ARN-14, 59, 67, 70
AN/APS-42, 81
AN/APN-1, AN/CPN-2A
Also: Tektronix, Hewlett Packard, Booten, and General Radio equipment, etc.

Liberty Electronics, Inc.

548 Broadway, New York, New York 10012, Phone 212-925-6000

Mark CB Catalog

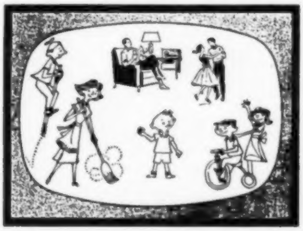
Mark Products Division of Dynascan Corporation has out a new catalog CB-659 describing their complete line of citizens band base station and mobile antennas, mounts and accessories. It's available from Mark Distributors, or from the factory at 5439 West Fargo Avenue, Skokie, Illinois 60076.

229
LAFAYETTE
RADIO ELECTRONICS

Lafayette Winter Catalog

If you haven't already gotten the new Lafayette Winter Catalog, you should. It's full of all sorts of interesting ham and other electronics equipment, Lafayette's as well as that from many other manufacturers. The number 662 108 page catalog may be obtained by writing to Lafayette, P.O. Box 10, Dept. 73PR, Syosset, N.Y. 11791.

LIGHTS! ACTION! CAMERA!



GO.....HAM TV.....GO

excitement FOR THE ENTIRE FAMILY!

Build a "live" TV camera cheaper than ever before! Simplest 5 tube circuit to date. EXCELLENT PERFORMANCE acclaimed by hundreds of constructors all over the country. EXPERIENCE THE FUN of televising the family and neighbors on your living room TV set!!!

ATV RESEARCH challenges anyone to put you on TV more economically than we can! Here's why; We furnish you with only the hard-to-find components and easy-to-understand plans. You supply the standard resistors, capacitors and hardware from your junkbox. In this manner practically everyone can afford to go TV...and have fun doing it!

Choose from 6 different kits (including printed circuit models). Prices start as low as $16.95.

Perfect for hams, experimenters, science students.

Why not get started NOW?? Begin by going closed circuit...televising on the living room TV...later expand to open circuit and QSO with your ham friends. You'll be amazed how simple TV can be when building with an ATV RESEARCH STARTER KIT...even if you've never had any TV experience. DON'T DELAY...DROP US A LINE TODAY.......

SEND 10¢ FOR NEW TELEVISION CATALOG. Comprehensive listing of kits, lenses, vidicons, etc. Also contains info on locating sources of free vidicons. Don't put it off! Write today!

P.O. BOX 396-S ATV RESEARCH So. Sioux City, Nebr. 68776

advised by my lawyers that
don't you ever proofread y
are a bunch of crooks and
this is the last straw for
have no other recourse but
should be tarred and feath

Letters

Wayne Green

Dear Sir:

Would suggest that you make some arrangements with a good university to—will—your brain? to them . . . at . . . death. So that through scientific research (an operation could be studied and then performed on children—to prevent a recurrence of the kind you apparently possess).

Dr. H. B. Cully WA8CPA
Podiatrist
Van Wert, Ohio

Thank you. I hope you enjoy the subscription to Bambi Comics we are sending you in place of your subscription to 73. . . . Wayne.

Mr. G. C. Bandy, KL7CVB
P. O. Box 840
Delta Junction, Alaska

Dear OM:

We're sorry to hear that you do not intend to renew your membership when it expires at the end of this year. Management can but follow the orders of the elected directors, who are charged with the formulation of League policy on all important matters. The directors in turn are elected from among the members of the League in the various divisions and they serve for two-year terms. It would appear that should the directors not follow the wishes of the members, then they would not be reelected at the next balloting. As a member, you have had the right to help nominate a candidate or stand for election yourself, and to keep your elected representatives informed as to your views. As a non-member, you would no longer have the right, and yet still would be influenced to some degree by the League's future course.

Though the Headquarters staff had no voice in determining the League view toward incentive licensing, I was present at the Board meeting, and would be happy to comment on any points which disturb you particularly. To that end, I enclose an envelope you could use for this purpose. 73,

Sincerely yours,
Perry F. Williams, W1UED
Assistant Secretary
ARRL

Mr. Perry F. Williams
American Radio Relay League
225 Main Street
Newington, Connecticut

Dear Mr. Williams:

Thank you for your letter of December 16th in regard to my termination of membership in ARRL.

During the past two years I have stated my reasons for opposing the so-called incentive licensing plan in letters to ARRL headquarters, FCC and Senator E. L. Bartlett; copies of my correspondence with both FCC and Sen. Bartlett were also forwarded to ARRL headquarters; a copy of my formal submission to FCC in opposition to the proposed rule-making also was sent ARRL headquarters; therefore I will not go into detail on the matter but if you are interested and so desire I would be glad to send copies to you.

I understand how the board of ARRL is elected, and that management supposedly follows policies laid down by the board who in turn are guided by the wishes of the electorate. In my own opinion, and in the opinion of a very large and ever increasing number of ARRL members, is that something is very odd about the actual practice in view of the actions of board and management over the past two years. Many are finding it rather difficult to believe the rank and file members have anything at all to say about League affairs unless it happens to be in agreement with management and board. In short, confidence in ARRL has decreased; there is no longer the pride in being a member when you suddenly realize you are no more than a name on a subscription list. That is a hard statement to make, but I fear a great many members feel that way as I am sure your membership list will show.

This situation did not come about entirely because of the incentive licensing plan; had the League used a more moderate approach the plan may have gone through, and been accepted by members. But the arrogance of the initial editorial on the subject, the deaf ear turned to each and every member throughout the affairs and the somewhat gloating attitude when FCC made their proposal, all combined to create resentment that will take a long time to die.

My personal concern with the proposal was the effect on emergency operations; the ARRL proposal RM499 would have virtually eliminated Alaskan emergency operations, and the FCC proposal would mean the loss of flexibility to an alarming degree. I have been in radio communications for more than 20 years; and I cannot believe the benefits to amateur radio to be derived from the proposal can possibly compensate for the damage that will be done to emergency communications, especially in this state where distances are so great and where in so many instances in the past the radio amateur has contributed so much public service, saved so many lives and was indispensable so many times.

The failure of ARRL to consider the effect their proposal would have on emergency communications was a very serious mistake. To those of us who consider amateur radio a public service first and a hobby second, ARRL has shown a lack of comprehension of the value of emergency communications that is alarming in view of their past influence with FCC. That influence, however, along with the prestige of ARRL has apparently decreased to an all-time low during the past year.

In reading the "Letters" section of QST it was noted that almost all letters published were in favor of the proposal; the opposition letters were selected apparently for their poor taste. It is inconceivable that this was a fair sampling of letters pro and con received on the subject. Nor do I recall one single article written for QST on the subject that did not follow the same ARRL line. If QST is the house organ of ARRL, "by and for amateur radio", would it not be reasonable to assume that those members opposing the proposal should at least have a chance to express their views in a sane, dignified manner?

In summary, my decision for terminating my membership in ARRL is the result of two years of thought on the matter; I hesitated last year, finally decided to try one more year in the vain hope the policies of the League would at least return to a consideration of all segments of amateur radio. Since that has not happened and is not likely to happen in the forseeable future, and since the prestige and influence of ARRL is steadily declining, I must allow my membership to lapse at the end of this year. It is my intention to continue working for amateur radio and in particular for the public service segment; the satisfaction in rendering assistance when it is needed means a great deal more to many of us than a prestige license or call sign.

Thank you for this opportunity to explain my reasons for terminating my association with ARRL.

Yours truly,
G. C. Bandy KL7CVB
Delta Junction, Alaska

Dear Wayne,

Eico puts in a nice big ad on their 753 and you put in one of those sterile, uninformative, "it's lovely" type of reviews. This article just doesn't do justice to the Eico.

Jim Feeney WA6CLZ
Orangevale, California

Most of our "test" articles are written by fellows who have bought a piece of equipment and like it well enough to tell everyone else about it. Most of our writers are average everyday hams, not technical geniuses trying to show off their erudition and thus you'll find equipment evaluated from the viewpoint of the user rather than the engineer. It is nice when a company makes an engineering coup, but often this is lost on us when the gear turns out to be miserable to operate. At any rate, let me repeat again, if any reader buys something new and feels that it is great enough so everyone else should know about it then let us know that you'd like to write it up and if no one else is ahead of you we can give it a try. . . . Wayne.

TS 418A 400-1000 meg signal generators, AM, PM or CW emission	**$325.00**
Ballantine 300 Voltmeter	**40.00**
Millivac MV-17C Voltmeter 1 mv-1000V	**75.00**
Lambda C-281M 125-325 v, 200 ma	**60.00**
Lambda C-481M 125-325 v, 400 ma	**95.00**
Lambda C-881M 125-325 v, 800 ma	**125.00**
Electronic Measurements 234AM 0-300 v, 0-500 ma	**125.00**
Electronic Measurements 204AB 0-500 v, 0-300 ma	**100.00**
DuMont 404 Pulse Generator 0.05-105 microsec	**175.00**
Hewlett Packard 212A Pulse Generator .07-10 µsec at 500 watts	**200.00**
General Radio 720A Frequency Meters 100-210 mc	**140.00**
Lamda Model 50 power supplies. 0-500 volts at 500 ma	**125.00**

TS-497B 2-400 Meg Signal Generator with manual	**$195.00**
Tektronix 514D Scopes	**$250.00**
Tektronix 514AD, later version of 514D.	**$275.00**
531 Tektronix Scopes, wide band scopes with interchangeable pre-amplifier versatility.	**$525.00**
RM31A Tektronix Scopes. Rack mounted version of the 531A Scope.	**$600.00**

Preamplifiers available at extra cost.

Tektronix 105 Square Wave Generator used for checking wide-band amplifiers from a few cycles to 20 mc.	**write**

All equipment used and surplus, in good condition.
Orders FOB Cambridge, Mass. Sorry we do not issue catalogs or lists

ELI HEFFRON & SONS, INC.

321-329 ELM STREET **CAMBRIDGE 39, MASS.** **EL 4-8572**

Dear Wayne:

I would like to suggest a little fodder for future editorials, since it looks to me like very little attention has been paid to the future of ham radio when, to my way of thinking, several interesting and perhaps dreadful possibilities lie ahead. To wit, the following questions:

1) Will the increased use of satellite and LASER communications open up more HF frequencies and relieve the pressure on the ham bands?

2) Will more sophisticated means of communications now in developmental stages actually constitute more of a threat to our VHF assignments than our HF assignments in the long run?

3) If, as Robert Sarnoff is fond of saying, in 20 years every person on earth will have his own private telephone which he will carry with him at all times (ála Dick Tracy) and every newborn baby will be issued a telephone number as he is born, what will be the role of amateur radio?

Of course, nobody knows the answers, but the possibilities are interesting to contemplate.

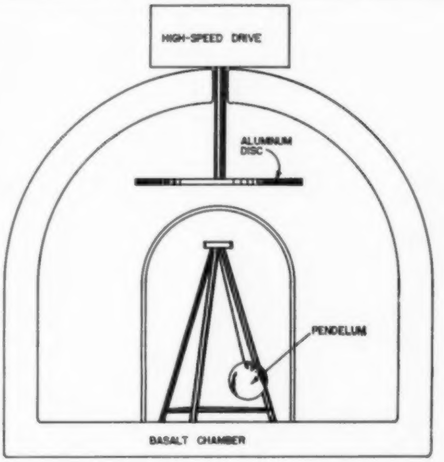
Fred Laun W9SZR
USIS, Caribbean Area

Niue Island
4 January, 1966

CORRECTIONS

The article on the regulated power supply on page 34 in the December issue has an error in Fig. 1. The 12 and 24 v positions of S2B are reversed.

W9SEK also says that difficulty with Q2 oscillating in the transmitter on page 8 in December can be corrected by replacing the .01 µf capacitor at the cold end of L2 with a .1 µf one.



In this experiment it was found that when spinning the disc at high speed, the Earth's G field was so modified as to cause the period of the pendulum to change. This experiment was performed at Franklin Institute. W8VHH.

Dear Wayne:

I have never read your column once, but the letters UFO can't be missed, so I read the January column from stem to stern. You hit the UFO problem on the head except for the method of propulsion. You will find that a gravity field has a fixed propagation time.

Robert Pielage W8VHH

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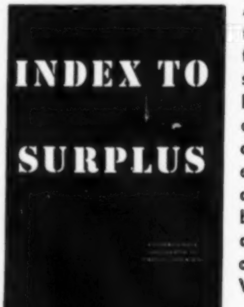

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73 Magazine
Peterborough, N.H. 03458

Dear Wayne,

I am not a licensed ham because of my attitude towards the CW-FCC ruling. I don't like any part of CW nor the frequency allocations set aside for same, nor the fact that most licensed hams can't and don't use it.

How about more articles for the SWLs and less about Xmiters and amplifiers.

More power to you and your mission.

S. M. Irwin
Fresno, California

Dear Wayne,

I enjoy your articles very much and agree with you on ARRL has done in the past and what the future looks like. I've been a member of ARRL for seven years only because I want to read the DX Column in QST. You should have a DX section in 73 to keep 73 growing.

John Shone K0TRG
Kansas City, Kansas

We'd love to have one if we could only think of some new approach. The column in QST seems awfully dull to me and I'd hate to strain hard and come up with a similar epic in trivia. I've been talking this problem over with KV4AA, W6KG, W4BPD, and other top DXers and may soon have something interesting to report.

Dear Wayne:

I just finished reading your January editorial. Reads fine all the way. As regards your policy on articles when accepted, let me say thanks for the check I received last week for the article that I sent you three weeks ago. As regards how long it takes to get into print, my article about the Florida style tower in the November issue was paid for in mid 1964, again just about three weeks after I sent it to you. I got more to read in the January issue for 50¢ than you get in that other one in three months for 75¢ a crack, and better reading at that.

Earl Spencer K4FQU
Fort Myers, Florida

Dear Wayne:

With reference to the personal static you reported in your January editorial, and recallling some of the things I've read about you in other publications, deponent states:

There is one untruth quite a few of us can expose. No one would believe that you could regularly offer us the work of a writer like Jim Kyle, for example, unless you paid well and promptly and published a magazine he could read without chagrin. So I suppose the charges of non-payment refer to the bulk of your contributors who, like myself, afflict you with manuscripts spasmodically (and write the same way). As one of these I can affirm that you have always paid on acceptance and in amounts nicely calculated to leave me with a slight feeling of guilt. To confirm a point you made I can add that on one occasion you published a contribution a year after I had spent the money received for it. I thought you had lost your nerve. Incidentally, don't fret about that sense of guilt—I can bear it.

As an Extra Class Gadfly you are certain to be swatted now and then as you probe sensitive areas, so I hope those amateurs who occasionally find themselves in agreement with your policy on specific issues will help generate a true consensus by signaling their approval with a letter.

A check for $3.00 for a 1966 binder is enclosed—this doesn't indicate I think you'll last out the year, it's just that I'm burdened with an orderly mind.

Ken Cole W7IDF
Vashon, Washington

Dear 73:

Mr. Eric Young's solution to the identification of amateur stations in January 73 p. 89, operated by persons other than the licensee is unusable because amateur operators do not carry call signs. Neither does a broadcast station disc jockey, engineer, announcer, owner, program director or any other individual have a call sign. Radio STATIONS have call signs. An amateur operator has a license but not call sign is associated with any individual. If you don't believe this get someone to apply for an operator license without filling in the blanks pertaining to the station. He will receive an operator's license with no call sign as I did on my first license when I had no permanent address and used Navy MARS Station rigs.

James Stuckey W5ZJO
Baton Rouge, La.

Dear Wayne,

I have a couple of comments about the editorial in the January '66 edition of 73, starting with a short lecture on *force:*

Electromagnetic forces (e.g. the coulomb force) are created by the exchange of photons and virtual photons between the two particles involved. Nuclear forces are due to the exchange of pions (pi-mesons) and virtual pions. (Nuclear forces are the short-range forces which hold a nucleus together despite the repulsive coulomb forces acting.) Similarly, people have postulated a particle, generally called a graviton, whose exchange leads to gravitational force.

The nuclear force can be described by the Yukawa form

$$F = \frac{F_0}{d^2} e^{-md}$$

Note that there are two parts, an inverse square part F_0/d^2 and an exponential e^{-md} which becomes very small as the distance between the two particles gets larger, and gives the force its short-range character. In this formula, m is the mass of the exchanged particle, a pion, usually written off.

In the case of an eletcromagnetic interaction, the exchanged particle is a photon, which has no mass. There is correspondingly no exponential term in the force formula, and we are left with the pure coulomb inverse-square law, $\frac{F_0}{d^2} = \frac{kqq^1}{d^2}$

Presumably, since gravitational forces are also inverse-square, the mass of the graviton is zero. This, however, doesn't exempt it from the requirements of relativistic mechanics, which work in every case we know about. One of the requirements of the relativistic formalism which has been developed is this: in order to avoid an ambiguity in cause-and-effect, i.e. to eliminate the possibility that in some frames of reference an effect happen before its cause, we must require that, even in theory, no interaction propagate at more than the speed of light. This would apply to any interaction, even to interactions caused by massless particles like the photon, the neutrino, and, if it exists, the graviton, because it is not derived from the mechanics of an interaction. It is derived from the nature of space and time, as we know them, and the requirement that "if A causes B, then A must occur before B"

Further comment: I disagree with your statement that "We have no real idea of what it is that goes to the moon and bounces back . . ." etc. We understand light waves, or photons, or whatever you want to call them, as well as we understand anything else in physics, and a lot better than we understand any of the elementary particles which have mass and charge. Strictly speaking, I admit, we don't undrestand *anything*, but I think that it is misleading to say it the way you did. Certainly no one would say he didn't know what a moon-rocket was, although he may not understand the detailed mechanics of its operation.

Further comment: K1CLL was wasting his time, unless he was using a microscope to watch his antenna. Let's figure the force reacting on the antenna due to the 100 watts leaving it. Suppose that the entire signal went out in the forward direction, so that it was all pushing the same way. In one second, the energy sent out is 100 joules, since a watt is a joule/second. The momentum of this 100 joules is mo-

$$\text{mentum} = p = mc = \frac{E}{c} = \frac{100 \text{ joules}}{3 \times 10^8 \text{ m/sec}} = 3 \times 10^{-7} \text{ kgm/sec in one second.}$$

The force due to to this radiation is:

$$F = ma = \frac{m\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t} = 3 \times 10^{-7} \frac{\text{kgm}}{\text{sec}^2} = 3 \times 10^{-7} \text{ newtons}$$

Now suppose that K1CLL hung his beam from a 50 foot wire, and that it has a mass of 10 kg, that is a weight of 10 kg x 9.8 m/sec² equals 98 newtons. This means that the beam will want to be in a position slightly displaced from the vertical. We can calculate the displacement from similar triangles to be 10^{-6} inches.

Just by turning on his rig, K1CLL created a pendulum swinging around a new equilibrium point with an amplitude of about a millionth of an inch. Even if he had keyed the

HAMS,

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Peterborough, N.H. 03458

thing just right, in step with its oscillations, the way you push a child on a swing. I doubt that the Q of such a mechanical system is more than 10,000 so he couldn't have got an amplitude of more tan a ten-thousandth of an inch.

Thus, your statements are correct—the beam didn't move a hundredth of an inch. But your conclusion, or at least your implication, is completely wrong.

Incorrect statements like this cast a shadow on the rest of what you say. Still, you're making hams think, which is more than most of them would do otherwise. Keep it up.

Roger Chaffee W1IQQ
Berkeley, California

Dear Wayne:

Re your editorial in January 73—I have been waiting for some time for some interest to develop in the direction of using gravity as a means of communication. Your article will probably cause several letters to be written as I am reasonably sure that there has been enough evidence collected to show the possibilities of that system or mode or whatever you want to call it. Now, I am not interested in going into the UFO angle at present, but what I would like to see is the possibility of using your magazine as a sounding board and central collection agency for tests, experiments, and descriptions of models—or even some speculative articles on ways and means of using gravitational forces as a communication medium.

In 1959, while working with a three axis accelerometer for an inertial navigation system it occured to me that some of the effects noticed while two similar systems were operating adjacent to each other could be attributed to gravitational forces and that the system did provide communication possibilities—and further, of course, provided a method wherein the velocity of propagation of the "wave" could be measured. Incidently, this accelerometer (one I developed) was sensitive to the category of 10^{-10}g. I wrote a disclosure on the effects noticed and attempted to describe the mechanism involved; in particular, a description of the variation of gravitational forces under dynamic conditions as compared to static conditions and certain other intuitive feelings concerning equal masses in the systems (possibility of resonance), etc.

I did not send the disclosure to the patent office or attempt to do anything with it at that stage. I perceived that I probably had not accurately described what I had observed (terminology yet to be developed) and further that even if the system were patentable the time delay between discovery and actual practical reduction to practice would probably exceed the life of any patentable protection.

It occurred to me that there was an analogy possible between the development of a gravitational "action at a distance" system and that which has occurred in electro-magnetic technology. It also occurred to me that radio amateurs would be the best developmental team approach to reduction to practice. I can see a parallel, for instance in the old coherer and silver filing detectors as compared to the detector that I used. In many of the early electro-magnetic experiments the helpmate of resonance was not used although it is probably fortunate that Hertz did have resonance of sorts with the spark gap supporting rods used on his leyder jars. (Hertz's system was probably resonant around 250 mc)—and there are of course, the esoteric teachings of Nikola Tesla in regard to resonance.

I can fill many pages with further information about the possibilities of using the gravitational approach, but before I rave on I feel I had better wait for an answer from you as to how you feel about these things. The articles you could or would publish (at least initially) would have to be carefully worded so as not to alienate your present audience or cause unkind comment about the condition of your mental faculties.

Incidentally, I have no intention of attempting to patent this system or concept. I just think it would be fun to watch the development, especially by radio amateurs, whom I hold in high regard for their practical research abilities.

I am prepared to write a lead article going into detail about the possibilities—and then several articles on construction of simple equipment to verify the effects that I have observed—and then the door is open if a few of the guys will pick it up and help develop—are you interested?

W. E. Barker Jr. W4YGT
Gainesville, Florida

Sure. . . . Wayne.

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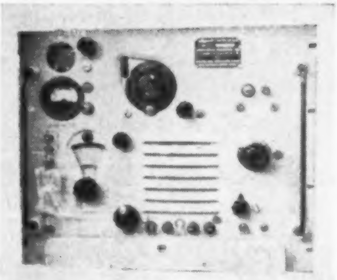

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73 Magazine Peterborough, N. H. 03458

Dear Wayne:

As a loyal ARRL member I usually find your editorial rather disagreeable, to say the least. Not so in your January issue, however. Your discussion of UFO communication, etc., has filled a void that has long existed—serious consideration of UFO's in a national magazine. As you have probably guessed, I am a firm believer in them. However I would like to take issue with one point you made. You seem to take the view that we should not "let them know what we know about them." You then made the statement that this subject should not be discussed over the air. It is my belief that the very fact that UFO's have apparently been visiting our planet for hundreds of years shows that their intentions with us, if any, are peaceful. I think they want us to know they are there, and their increasing frequency of visits is a way of getting us used to seeing them. I suggest, therefore, that instead of keeping quiet on the air, we should make it a point to let them know that we are interested. In effect to say "if any of you guys up there are reading the mail, drop down for a visit." Who knows, a ham may establish the first recorded "QSO" with an UFO.

Craig Smith W2BHP
Endicott, New York

Dear Wayne,

Somebody's been reading "The Day After Tomorrow" (or Sixth Column) by Heinlein. (Or has John Campbell been ghostwriting your editorials?) Although I have never heard of the Biefeld-Brown effect, I would be interested in trying the experiment. One guess as to what the cause of the orientation change is is that the molecules and atoms of the dielectric exhibit a magnetic dipole moment as well as an electric one. If the effect disappears in a vacuum capacitor, this might be the answer. If it is still present, throw out your old textbooks.

The one physical fact that makes modern electronics possible is the charge to mass ratio of the electron. Because it is possible to exert an enormous force on an unbelievable minisucle amount of mass, it is possible to accelerate electrons by billions of miles per second per second. The gravitational "charge" to mass ratio so far as is known is one to one. If there is any electro-gravitic field radiated by an oscillating mass, it will be very, very small indeed if the two types of radiations are analogous in that they depend upon mass (or charge) and acceleration. Of course, they may not.

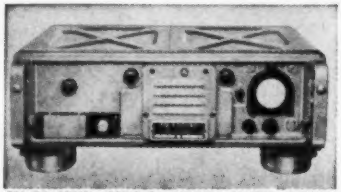
Then, there is the unexplained nuclear force, which over short distances is even more powerful than electric forces. If someone discovered how to radiate a field which microscopically changed nuclear interactions, it might be possible to communicate with such a field if it were possible to decode it. Since almost all experiments in nuclear mechanics deal with statistical methods, probably no one would notice if atomic characteristics were changing by miniscule amounts millions of times per second. Sound ridiculous? Everyone knows that it is impossible to generate a coherent light beam. (If I remember correctly, bumble bees can't fly either.)

Beginning of digression on your digression. If K1CLL had measured more carefully he would have found a force on the beam, assuming perfect reflection. The phenomena of radiation pressure is well known and accounted for. It is normally so small as to be measurable only under laboratory conditions. However, it has been proposed as a method of spaceship propulsion. In space, where there is no atmospheric resistance, a ship would inflate large "sails" of reflecting metal, place them between itself and the sun, and go sailing off into the star rise.

If you're in a bad mood, don't read the rest of this.

I'm ashamed of you for saying "Needless to say, this is something that you should not discuss over the air . . ." I feel compelled to launch into a passionate defense of freedom of speech but haven't got the time. Do you seriously think that beings who are capable of building devices which do what the UFO's have been reported to do rely on short wave radio only for intelligence data? And do aforementioned beings *need* intelligence data. I believe that we both believe that bureaucracies busily keep secrets from the populus more to justify the existence of the bureaucracy than from a real need to keep the secret secret. (Or to hide bungling). If you don't believe this, call up the local telephone company and try to find out the difference between a G1 and a G3 handset.

Richard Factor WA2IKL
New York, N.Y.



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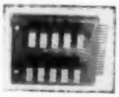

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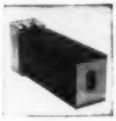

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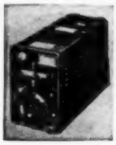

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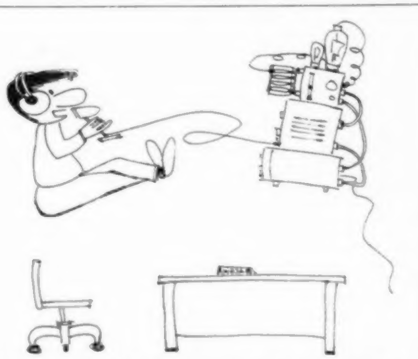

Now I know Wayne Green has gone nuts! In the January 73, Wayne said he expects hams will stumble onto the key to electro-gravitism!

Dear Wayne:

Actually, I am quite interested in electrogravitism, and would like to get hold of more information. While the so-called laws of gravity have been established for a long time, any physical explanation or definition for the gravity field has scarcely been touched on. And just as electro-magnetic waves were discovered and used before they were defined by physicists, it is possible that other types of fields and media will be discovered and used quite by accident by people who like to experiment for personal enjoyment.

I will be looking forward to any further information on these ideas in future issues of 73.

Paul Gihring W9JAB
West Allis, Wisconsin

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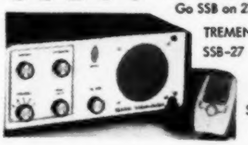

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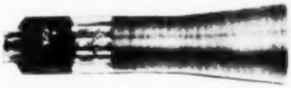

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(W2NSD from page 86)

Gus W4BPD with the usual Coke in hand at Miami.

haps we should set some sort of agreed limit on QSL's . . . say one dollar each. This way you can get your first hundred countries free, since there are at least one hundred easy to work countries. From then on you could figure on a buck a QSL. Shucks, it costs you $6 for a day of skiing, so why not $5 to work five rare ones some day?

In case there are some of you who have skipped my past editorials I suppose I should mention here that the above is intended to be sardonic. I think the whole idea of charging for QSL's is terrible.

The FCC seems to have a low threshold on their sense of humor where it comes to picking up a little dough from QSL's too. I note that you'd better be very clean if you intend to use your U.S. call with a portable designation. If you are using a DX call there isn't much they can do. Of course the secret to this whole problem is the acceptance of these operations as legitimate by the League. If the League put their foot down about paid QSL's then there would be no problem and no incipient FCC action, etc.

Perhaps 73 should take the tiger by the tail and demand some sort of proof from DXpeditions that they are actually where they say they are . . . photographs, documents, something . . . and then cancel any operation where QSL's or contacts seem to depend on contributions. This is suggested as an answer to the critics of DXpeditions, not as a criticism of them. With the exception of the CEØ trip I've gotten most of the QSL's for the DXpedition contacts I've made . . . and I haven't sent any donations. I'm ready to pay well for articles on these jaunts and that'll have to do for me. For instance, if the CE0 story had appeared in 73 we would have paid about $120 into their kitty . . . maybe a lot more.

Of Small Note

R. Lumachi WB2CQM has asked us to mention that the article in the November 73 by him was rewritten by us. We did rewrite it, extensively. We rarely have to do this.

Miami

The Hamboree has pointedly not been asking 73 down to exhibit for the last couple years. One of the officials got me aside and apologized, saying that they had orders from QST Headquarters not to let 73 in. Since this doesn't keep me away from the convention I expect that they are mostly afraid that 73 will sell a few more subscriptions and are trying to hurt us financially as much as they can. Pretty small potatoes.

Many fellows commented on the scant turnout this year at the Hamboree. I was surprised too. The old days when the manufacturers came down to exhibit in strength seems to be a thing of the past. The place looked deserted. This is a shame because Miami in January is certainly the right place at the right time.

I've been asking around, trying to get some idea of what is happening to ham conventions. Quite a number of fellows down in Florida that I've contacted on 20 meters said that the reason they didn't go is because they don't want to support a QST convention after the kick in the teeth they got on the incentive licensing proposal. I did note that only two of all the people I had a chance to talk with at the Hamboree were in favor of the proposals and many wanted to know where that

Wayne W2NSD/1 talks over DX with Wayne W4ZZV (HR2WC).

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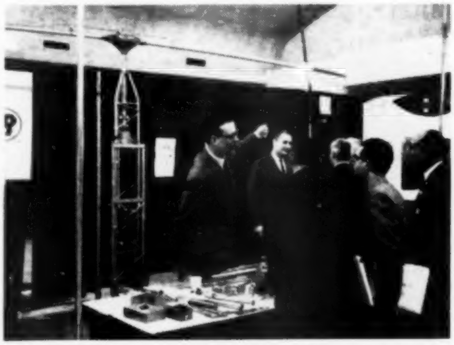
Paul WA1CCH goes over some VHF articles with Jay W4VTJ.

50% was that QST claimed supported them. They sure must be in hiding somewhere for they don't come to conventions.

We'll all be watching to see what kind of turnout they have at Dayton this year. This is the only big non-QST convention going. This may tell us whether it is conventions in general that are going out of style or just QST Conventions. And is there anything as dreary as a convention with no people?



Newtronics drew a smashing crowd, comparatively, with their Hustler antennas.

Boston

QST continues its economic embargo of 73 by insisting that 73 not be permitted to sell subscriptions at the Boston convention. It's OK if I come, but no booth . . . hi. I dunno . . . I called the hotel and they quoted me $55 for a room *per night*. Add that to the $13 for the convention and a big lump for parking my car and I would do better to go down to Bermuda for a couple days . . . and I would save money.

. . . Wayne

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COLLINS 32V1 transmitter, good condition, $75. Tecraft 6 meter converter with Tecraft power supply, $30. 5 element 6 meter beam CushCraft, 1 year old, $15. 11 element 2 meter beam CushCraft, new, $10. CDR TR-44 antenna rotor good condition, $30. Two surplus 432 mc UHF transceivers: 1 with AC supply and 1 with dynamotor, $15. A lot of other junk. Gerald S. Blanchard, Box 205, Hillsboro, N.H.

QSL CARDS: Samples 10¢. Quality—reasonable—fast service. Decals, rubber stamps, photo labels, log books or loose leaf. Malgo Press, Box 375, Toledo, Ohio 43601.

CANADIANS: HAMMARLUND HX-50, SSB, CW, AM with PTT, VOX. HQ-170A adjustable AVC, selectivity, notch filter, noise limiter, selectable sidebands. Write S. Ranti, 3465 Limoges, Montreal.

GOT MORE GEAR than I need. Transceivers, etc. Send SASE all inquiries answered. Kris Krysaik, P.O. Box 465, Sebring, Fla. 33870. Phone EV5-7353.

ATTENTION NEW HAMS: New complete ham station. Includes Eico 720 transmitter, Hallicrafters S-108 receiver, Eico 722 VFO, plus crystals, others. List $400. How about $250? Joseph Sanger WB2SSB, 22 Teakwood Lane, Roslyn, L.I., N.Y. MA 1-5158.

TELEVISION CAMERA. Vanguard model 400 less vidicon and lens, $75.00. RG-17 coaxial plugs $3 each. Jack Schmermund, 401 North Main Street, West Milton, Ohio.

ALL GALAXY Galaxy III, AC supply in speaker cabinet, external VFO, VOX, Rejector-All $340. Want SBE 34. No ship. W2GDZ, 212-VI 6-0396.

AN/URR-13A receiver $88; APR-4 receiver AM/FM 38 to 2200 mc $165; HP/130B $288; GR/1551A $149; TS239A scope $49.50; FOB Hathorne. P. E. Boniface, P.O. Box 44, Hathorne, Mass.

HAMFEST-STERLING (Northwestern) Illinois, March 13, 1966, Sterling Coliseum. Advance registration $1. Sterling-Rock Falls Amateur Radio Society, P.O. Box 11, Sterling, Ill.

COLUMBUS (GEORGIA) HAMFEST on March 27 at the Fine Arts Building at the Fairgrounds. W4FIZ, 3804 Conrad Drive, Columbus, Ga. 31904.

VIKING 6N2 transmitter, Viking 6N2 VFO, Ameco converter CN-144, VHF preamp PV-50, power supply PS-1W, Heath Twoer, Heath Hybrid Phone Patch, David Decobert, 609 Henrietta Street, Gillespie, Illinois.

SB-110 with AC-DC supplies. Has not been checked on the air, $400. HW-10, $150. Will ship PP or deliver within 100 miles of Jacksonville, Fla. Ens. John Butrovich III, USS F. D. Roosevelt CVA-42, FPO New York, N.Y.

CB-253/ALR 30-1000 mc converter with RDO receiver, and model 14 keyboard typing reperforator. Want to trade on 75A4 or 51J class receiver. W0DNW, W. O. Wesslund, 2801 Wright Ave., North Platte, Nebraska.

HALLICRAFTER SR-150 transceiver like new for $385. Topaz 800 volt 250 watt mobile 12 v power supply, $75. Hy-Gain 20 meter 3 element beam, $30. W. H. Paxton K6ZHO, 720 Glenandale T., Glendale, Calif. 243-5979.

CERAMIC DISC CAPACITORS: .01 @ 600 v only 5¢ each. KKI2617, Box 6111, Baltimore, Md. 21231. Minimum order $1 plus 15¢ postage and handling. Stamps accepted.

SWAN 240 $200. Swan 117AC supply $75. Gimbel bracket included. Excellent condition. Will arrange sked. Lloyd D. McKillips K1ZTB, 317 Hickam Drive, Loring AFB, Maine.

WANTED TR-¾, NCX-5, S-Line. Condition unimportant. Cash and/or trade for Collins 310B-3, 51J2. State terms, condition, serial. R. Klein W3WXC, 7 Louella Drive, Norristown, Pa. 19401.

ELMAC STATION 80 through 6 meters. AF-68 transmitter, PMR-8 receiver, AC/DC supply. Excellent condition. $250. W. K. Gillen W2LBC/1, 845 Boylston Street, Boston, Mass. 02116.

HALLICRAFTERS HT-40 transmitter and Finco A-62 6 and 2 meter beam. Goes to highest offer. Ham, Rothbury Road, Wilmington, Delaware 19803.

MICHIGAN HAMS: Don't miss the Michigan State Convention in Saginaw on March 18 and 19 at the Bancroft Hotel. Details from W8CAM or WA8GRI.

FT-243 CRYSTALS: .01% setting $2.00 each, ±2 kc setting $1.00 each. 3000-8700 ks. Denver Crystals, 776 South Corona, Denver, Colorado 80209.

QSL CARDS?? "Made-to-order." Samples 25¢, deluxe 35¢, (refunded). Sakkers, W8DED Print, Box 218, Holland, Michigan.

TOOOOBES: 6146B $4.00, 6360 $3.45, 6CW4 $1.40, 8058 $8.55, 6146 $2.55, 417A $3.95. BRAND NEW. No pulls, seconds or JAN. Catalog free. Vanbar Distributors, Box 444X, Stirling, N.J. 07980.

MOTOROLA new miniature seven tube 455 kc if amplifier discriminator with circuit diagram. Complete at $2.50 each plus postage 50¢ each unit. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

POCKET STAMP (up to four lines) or 1000 labels (six lines) with call. 75¢ postpaid! Wholesale catalog (5¢ please). Brownville Sales Co., Stanley, Wisc. 54768.

HQE180C $250, Viking Valiant F/W $200, NC 303 $250, 6N2 matching VFO $95, Gonset G50 $200, all equipment with manuals and in good condition. William E. Daupert, Route One, Lebanon, Indiana 46052.

HQ170C with speaker $165. Art Linehan K-ZCP, 124 A Street, Manchester, N.H. 622-1602.

SOUTHERN NEW ENGLAND HAMS: Auction of the year, March 8, 1966. Cronslaw Post, 40 Jones Street, Cumberland, R.I. Write for details to K1PNI, 133 Larchmont Rd., Warwick, R.I.

HEATH SB300 RECEIVER, six meter converter, speaker, excellent, $275. Utica 650A transceiver, VFO, like new $170. WA1BTE Paul LeTourneau, I LeTourneau St., Rochester, N.H.

HAMMARLUNG HQ170 with clock $267, Hallicrafters HT-37 $267. Only 1½ years old and excellent. Both for $499. Write or phone 644-2179, George Swiney K0SIM, RFD 1, Bennett, Colorado 80102.

AMPLIDYNE 621 TRANSMITTER. Never used $195.00. 30 tube square wave generator $30.00. VHF transmitter strip $2.00. Jerry Hirsch, WA2ZFA 215 California Dr., Buffalo, N.Y. 14221

DYNAMOTORS: 12v input 1000v 350 ma output $24.95. 12v input 1000v 250 ma and 500v 200 ma $27.95. Generator: requires gas engine drive, 1000 v 400 ma output $46.95. WA2OVR, 13 Kent Street, Trenton, N.J. 08611

I WOULD LIKE to trade my excellent Utica 650 six meter transceiver and VFO for an excellent two meter rig. Terrance M. Neal, 1127 Salvador St., Costa Mesa, California WB6HWL.

YUBA-DALMOTOR KW liquid cooled mobile linear $100. 32V-3, $175. KWS-1, 75A-4, 2.1, 3.1, 6 kc filters, speaker, $1000. KWM-1, all accessories, $400. James Craig W5VRO/1, 172 White Birch Drive, Pease AFB, N.H.

LIKE NEW SBE-33, mobile supply, amount, $290; excellent Valiant, $175; Hy Gain 14AVS and roof mount, $18.50; four 6146's, $12, Albert Johnson K1IIK, Newport, N.H. 03773.

W2AU CUBICAL QUAD 2 element for 10-15-20 meters. Never used. Complete instructions $40. Pick up deal only—Sorry. J. J. Doran, 178-09 132 Avenue, Jamaica, N.Y. Telephone LA 87269.

GLOBE CHAMP 300: 160-10 meters. 275 watts fone, 350 c.w., 500 p.e.p. with adapter. $150 or offer. WA8MZK Hilton Muntz, 417 Norway, Norway, Mich.

SPECIAL FILAMENT XMFR. 120v. 60 cy pri., 2 secondaries 7.6v @ 21 amp and 5.1v @ 13 amp. New. Sealed. $4.50 plus postage. Wt. 14 lb. A.R.C. Sales, P.O. Box 12. Worthington, Ohio.

SPECIAL SMALL SCOPE TUBE. $1\frac{1}{16}$" dia. and 6" long. 6.3v Fil. Low anode and deflection voltages. Electrical data furnished. $6.95 plus postage. Wt. 1 lb. A.R.C. Sales, P.O. Box 12. Worthington, Ohio.

NOVICE CRYSTALS 80-40M $1.05 each. Also other freqs. Free list. Nat Stinnette W4AYV, Umatilla, Fla. 32784.

WRL BLUE BOOK prices save money. Take 10% off these low prices without trades. TR3—$399.00; SB34—$319.00; Galaxy III—$219.00; Galaxy 300—$199.00; SB33—$209.00; NCX3—$219.00; SR150—$389.00; HW22 and HW32—$129.00; Communicators—III/6m—$159.00; IV/6m—$219.00; SR34AC—$199.00; Sidewinder 2m—$299.00; Polycom 6—$199.00; hundreds more. Free list, LEO, W0GFQ, Box 919, Council Bluffs, Iowa.

WANTED: Ruined equipment to rebuild. Wrecked, burned or worn out receivers and transceivers. Wa4NXC, RFD 2, Lincolnton, N.C.

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We'll pay you the absolutely Highest Prices for almost any piece of equipment in any condition. We'll trade also. We'll pay in 24 hours too. Just send list, or telephone collect for quick quote. Particularly interested in all AN/GRC, PRC, ARC, ARM, UPM, USM APR, APN, URM, RT-66-70, T-195, R-392, etc. SPACE ELECTRONICS, 4178 Park Ave., Bronx, New York 10457, (212) CY 9-0300.

ARC-21 IF & Audio strip, 16 tubes, 2 mech filters, squelch, ANL, BFO, AGC, AVC, conversion instructions and ideas to make into AM or SSB fixed freq. receiver	$12.50
ARC-21 Strip Schematic	$1.00
ARR-36 Receiver, 45 tubes, mech filters	$295.00
SB-33 or SWAN 240 Transceivers	$225.00
URD-2A VHF Receiver, 100-156 mc. 60 cycle	$99.00
Sony tape deck, excellent	$65.00
LA-6 Lavois Frequency Meter, 100-500 mc. plush	$595.00
SA-84 Polorad Spectrum Analyzer-Receiver	$1995.00
2N243 Silicon Transistors	4/$1.00
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RCP-1, National receiver, like NC-101	$68.00
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	25 mmf, 600v, ¼ x 1½"	59¢ ea 4/$2.25
APC	100 mmf, screw driver	49¢ ea 4/$1.75
APC	15 mmf, 600v slotted bakelite	39¢ 3/$1.10
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	RG8A/U cable, with UG-21D/U each end. BRAND NEW. 16" 59¢ ea 4/$2.25; 24" 69¢ ea	3/$1.95

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RT82/ APX-6	1215 to 1296 MC transponder & "MOON-BOUNCE". Excel. used. less all tubes, with cavities. 40 lbs	$7.50
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PANADAPTER. 30 MC ± 5 MC imput

IP274/ ALA-10	400 cycle power supply. Excel. used, with all tubes and internal parts. With instructions for solid state 60 cycle power; and to 14 MC, if desired. 35 lbs.	$22.50

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CERTIFICATE will be issued by Henry Ford Museum to any station that works the Motor City Radio Club station, W8MRM, during the 24 hour prior to the Old Timers Night banquet. Work W8MRM on May 7 (GMT) on or near 1.815, 3.663 (even hours), 3.900, 7.070 (odd hours), 7.215, 14.300, 50.178 or 146.94 Mc. Novice contacts by schedule. QSL for certificate.

CLERGYMEN OF ALL FAITHS! Sixth edition of "Clergy and Religious Radio Operators" callbook to be published soon. Please inform us of additions and changes. Over 1000 calls now included. No cost or obligation. Write: Callbook, Capuchin Seminarians, K1QFT, Box 218, Hudson, New Hampshire, 03051.

DAYTON HAMVENTION April 16, 1966—Everyone welcome at the Dayton Amateur Radio Association's 15th annual Hamvention, Wampler's Ballarena, Dayton, Ohio. Come and participate in the technical sessions, forums and banquet. See new equipment exhibits. Take part in "Home Brew" contest and hidden transmitter hunt. New this year Giant "Flea Market." Activities for the XYL. FCC general class examination at 09:00 Saturday. Exhibits open Friday evening. For information write Dayton Hamvention, Department F, Box 44, Dayton, Ohio 45401.

HAMMARLUND HQ-145-X, in very good condition, with 24 hour clock timer. Only $175. Contact Derrick W. Vogt, 130 Venice East Blvd., Venice, Florida 33595.

DX-40 with key, microphone, and new tubes; HR-10 with speaker; antenna relay; everything in good condition. Everything for $75. Frank Amendola, 11 Thornwood Place, Scarsdale, N.Y. 914-725-1591.

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HQ-170AC nearly new, electrically and mechanically perfect. Shipped in original factory carton. $275. Ameco CN 144 50 MC i.f. $35. Roger Melen WB6JXU Rt. 2, Box 486-M, Chico, California.

"BUGCATCHER" mobile antenna coil, unused, $12.50. Two KVA. transformer, 110-220 primary: 7200 center-tapped secondary, $30.00 or swap for 4-1000A. W5GPQ, 9955 Kittrell; Houston, Texas, 77034.

HX-10 (professionally tuned) $250; Drake 2-B, 2-BQ, 2-AC, $210; Dow-Key TRP tr switch $15; Want 75S-3, 32S-3, 516F-2; K1SCQ, Ralph McClintock, call 617-696-2575.

UHF ASSOCIATES VARACTOR trippler to 432 mc. $25. Two meter Sidewinder $250 less power supply. Write W0EOF, 211 S. 7th, Sauk Center, Minnesota 56378.

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WANTED Goldkit Thriller or Norseman transceiver in good condition. Box 272, Savannah, Georgia 31402

WANTED British EL37 DX transmitter in fair condition. Box 590, Savannah, Georgia 31402

COMPLETE SIDEBAND STATION! Hammarlund HX-50, $260. HQ-145XC with clock, S-200 speaker, calibrator, product detector, SSB and CW AGC, $165. No holes in panel. HD-11 Q-Multiplier, $15. Package deal $400. will ship. Macdonald, K2GKK/5, 1033 Usher, Fort Worth, Texas, 76126.

COLLEGE. Wired Eico 753 Tri-bander, Heath HP-23, Shure 520SL and Stand, $300. Eico 753 Kit in sealed box, $185. K9VWQ, 1205 Tanglewood Rd., Manitowoc, Wis.

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SAMCO, QSLs presents "Proto-Call" for '66; samples 10¢. Rubber Stamp Owners—STAMP-ETT multi-purpose cards only $1. hundred, ppd. Samco, Box 203, Wynantskill, N.Y. 12198

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FOR SALE: Heathkit Seneca VHF-1 with two 6146 B's. Excellent condition. $159. Ed Stanley, WB2NQX, 112 Riverdale Rd., Liverpool, New York. 315-652-9492

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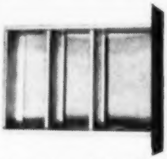

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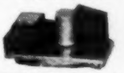
Wire and test the subchassis outside where everything is accessible. Assemble the subchassis into the unit chassis and you have a professional package.



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WALKIE-TALKIE #13-110H— 12 transistor—2 channels	SALE	$29.95
WALKIE-TALKIE #13-132— 16 transistor—2 channels—1⅓ watts	SALE	$68.88
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TURNER 454X SSB	SALE	$14.49
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IF's—455KC (¾ inch)	SALE	19¢
RELAYS—Kellogg Swb—6/35VDC— 4PDT	SALE	99¢
OUTPUT XFMR—10,000 Ohms— PP Audio	SALE	99¢
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TUBE TESTER XFMR— (Lots of Fil windings)	SALE	49¢
FILTER CHOKE—Shielded— 3Hy-320 MA	SALE	99¢
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Propagation Chart

March 1966

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	14	14	7	7	7	14	21	21	21	21*	21*
AUSTRALIA	14	14	7#	7#	7#	7	7	14#	14	14	21	21
CANAL ZONE	14	14	7*	7*	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	7#	7	7	7	7	7#	14	21	21	21
INDIA	7	7	7#	7#	7#	7#	14	14	14	14	14	7#
JAPAN	14	7#	7#	7#	7#	7	7	7	7#	7#	14	14
MEXICO	14	7	7	7	7	7	7*	14	14	21	21	21
PHILIPPINES	14	7#	7#	7#	7#	7#	7#	14	14	14	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	21	14	14
SOUTH AFRICA	14	7*	7	7	7	14	14	21	21	21	21	14
U. S. S. R.	7	7	7	7	7	7#	14	14	14	14	7#	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	21	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14	14	7	7	7	14	21	21	21	21*	21*
AUSTRALIA	21	14	14	7#	7#	7	7	14#	14	14	21	21
CANAL ZONE	21	14	7*	7*	7	7	14	21	21	21	21*	21*
ENGLAND	7	7	7	7	7	7#	14	14	14	14	14	7*
HAWAII	21	14	14	7#	7	7	7	7#	14	21	21	21
INDIA	7	7	7#	7#	7#	7#	7#	14	14	14	14	7#
JAPAN	14	14	7#	7#	7#	7	7	7	7	7#	14	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7#	7#	7#	7#	7#	7#	14	14	7#	14
PUERTO RICO	14	14	7	7	7	7	14	14	21	21	21	14
SOUTH AFRICA	14	7*	7	7#	7#	7#	14	14	21	21	21	14
U. S. S. R.	7	7	7	7	7	7#	7#	14	14	14	7#	7#

WESTERN UNITED STATES TO:

ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	7	7	7	14	21	21	21*	21*
AUSTRALIA	21*	21*	21	14	14	7	7	7	14	14	21	21
CANAL ZONE	21	14	7*	7	7	7	7	14	21	21	21*	21*
ENGLAND	7#	7#	7	7	7	7	7#	7#	14	14	14	7#
HAWAII	21*	21	14	14	7	7	7	7	14	21	21	21*
INDIA	14	14	14	7#	7#	7#	7#	7#	14#	14	14	14
JAPAN	21	21	14	7#	7#	7	7	7	7	7#	14	21
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	21	21	14	14	7#	7#	7	7	14	14	7#	14
PUERTO RICO	14	14	7	7	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	14	7#	7#	7#	7#	7#	14	14	14	21	21
U. S. S. R.	7#	7	7	7	7	7#	7#	7#	14	14	7#	7#
EAST COAST	14	14	7	7	7	7	7	14	14	14	21	21

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

Good: 6, 7, 11-13, 15-19, 23-25, 27-30

Fair: 5, 8, 10, 14, 20, 26, 31

Poor: 1-4, 9, 21-22

VHF DX: 7, 12, 21, 22, 31

"TAB" • TRANSISTORS • DIODES!!
GTD! FACTORY TESTED — FULL LEADS.

PNP 100Watt/15Amp HiPower TO36 Case! 2N441, 442, 277, 278, DS501 up to 50 Volts/VCBO $1.25 @, 5 for $5. 2N278, 443, 174 up to 80V $3 @, 2 for $5.

PNP 30 Watt, 2N155, 156, 235, 242, 254, 255, 256, 257, 301, 392, @ 35c, 4 for $1
PNP 2N670/300Mw 35c @, 4 for $1
PNP 2N671/1Watt 50c @, 3 for $1

PNP 25W/TO 2N538, 539, 540, 2 for $1
2N1038 6/$1, 1039 4/$1, 1040 $1
PNP/TO5 SIGNAL 350Mw 25c @, 5/$1
NPN/TO5 SIGNAL IF, RF, OSC 25c @, 6 for $1

Silicon PNP/TO5 & TO18 25c @, 5 for $1
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Diode Power Stud Mica Mtg 30c @, 4/$1

ZENERS 1Watt 6 to 200v 70c @, 3/$2
ZENERS 10Watt 6 to 150v $1.45 @, 4/$5
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STABISTORS up to 1watt 5 for $1

TRANSISTORS—TOO MANY! U-TEST

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Untested TO36 up to 100Watts 3 for $1
Untested TO5/SIGNAL/sistors, 20 for $1
Untested Power Diodes 35 Amp 4 for $1
Untested Pwr Studs up to 12Amp 12 for $1

D.C. Power Supply 115v/60 to 800 Cys. Output 330 : Tap 165V up to 150Ma. Cased $5@, 2 for $9

SILICON POWER DIODES • STUDS

DC AMP	50Piv 35Rms	100Piv 70Rms	150Piv 105Rms	200Piv 140Rms
3	.08	.14	.17	.24
12	.30	.55	.70	.85
18*	.20	.30	.50	.75
35	.70	1.00	1.50	2.00
100	1.65	2.05	2.50	3.15
240	3.75	4.75	5.75	8.75

DC AMP	300Piv 210Rms	400Piv 280Rms	500Piv 350Rms	600Piv 420Rms
3	.29	.30	.40	.48
12	1.00	1.35	1.45	1.70
18*	1.00	1.50	Query	Query
35	2.15	2.45	2.75	3.33
100	3.75	4.00	5.50	6.00
240	11.70	17.10	23.94	29.70

*P.F. PRESS-FIT AUTOMOTIVE TYPE!

18 Amp Press Fit up to 200Piv 4/$1!
2 to 8 Amp Studs up to 600Piv 6/$1!
35 Amp Studs 150 to 200Piv 5 for $5

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NEWEST TYPE! LOW LEAKAGE

Piv/Rms 50/35 .05	Piv/Rms 100/70 .09	Piv/Rms 200/140 .12	Piv/Rms 300/210 .14
Piv/Rms 400/280 .15	Piv/Rms 500/350 .19	Piv/Rms 600/420 .23	Piv/Rms 700/490 .27
Piv/Rms 800/560 .35	Piv/Rms 900/630 .45	Piv/Rms 1000/700 .65	Piv/Rms 1100/770 .75

GTD ALL TESTS AC/DC & LOAD!

1700 Piv/1200 Rms/750 Ma/$1.20 @, 10/$10
Same 1100 Piv/770 Rms 75c @, 16/$11
3 Kv/2100 Rms/200 Ma/$1.80 @, 6/$10
6 Kv/4200 Rms/200 Ma/$4 @, 3/$9
12 KV/8400 Rms/200 Ma $8 @, 2/$14

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PRV	7A	16A	PRV	7A	16A
25	.90	1.00	250	2.70	3.00
50	1.00	1.35	300	3.00	3.45
100	1.60	2.15	400	3.75	3.90
150	1.95	2.45	500	4.75	4.80
200	2.29	2.80	600	5.45	5.65

UNTESTED "SCR" Up to 25 Amps, 6/$2
Glass Diodes 1N34, 48, 60, 64, 20 for $1

Two RCA 2N408 & Two Regulators RCA 1N2326 on prtd ckt. 80c @, 4/$1

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"TAB" Tubes Factory Tested, Inspctd. Six Months Guaranteed! No Rejects! Boxed! GOVT & MFGRS Surplus! new & Used

Low Prices! New XMTTG Tubes!

4-65A	$7.00	4X150A	$6.75	OB2	.55
4-125A	15.00	826	Query	5R4WGA	3.50
4-400A	25.00	829B	7.29	24G	Query
4-1000A	75.00	872A	3.50		
		0A2	.65		

We Swap Tubes! What Do/U Have?

0A3	.80	5R4	1.00	6F7	.90
OC3	.70	5T4	.90	6F8	1.39
OD3	.59	5V4	.89	6H6	.59
OZ4	.79	5Z3	.89	6J5	.59
1L4	.82	6A7	1.00	6J6	.59
1R4	5/$1	6A8	.90	6K6	.59
1S4	.78	6AB4	.59	6L6	1.19
1S5	.68	6AC7	.72	6SN7	.73

Send 25c for Catalog!

1T4	.85	6AG5	.65	6V6GT	.90
1T5	.95	6AG7	.75	12AU7	.69
1U4	6/$1	6AK5	.69	12A6	.45
1U5	.75	6AL5	.55	25L6	.73
[illegible]A	[illegible]	6AQ5	.66	25T	4.00
2C40	5.50	6AR6	1.95	28D7	.59
2C43	6.50	6AS7	3.49	50L6	.59
2C51	2.00	6AT6	3/$1	83V	.95

We Buy!		We Sell!		We Trade!	
2D21	.65	6BA6	.59	250TL	19.45
2K25	9.75	6BE6	.59	VR92	5/$1
2K28	30.00	6BK7	.99	388A	3/$1
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2X2	.48	6BY5	1.19	450TL	43.00
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Top $$$ Paid for All Tubes!

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866A Xfmr 2.5V/10A/10Kv/Insl $3 @
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(Sd) Choke 4Hy/0.5A/27Ω $40 @, 2/$36
"VARIACS" L/N 0-135v/7.5A $15
"VARIACS" L/N 0-135v/3A $10
TWO 866A's & Fil. Xfmr. $6

SILICON TUBE REPLACEMENTS

OZ4 UNIVERSAL $1.75 @, 2/$3
5U4 1120Rms/1600Irv $2 @, 3/$5
5R4 1900Rms/2800Inv $9 @, 2/$15
866 5Kv/Rms - 10.4Kv Inv $11 @, 2/$20

Mica Condsr .006 @ 2500V 4/$1
Snooperscope Tube 2" $5 @, 2/$9
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4X150 Ceramic Loktal $1.25 @, 2/$2
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Line Filter 50Amp/250VAC $10 @, 2/$16

DC 3½"/Meter/RD/800Ma $4 @, 2/$7
DC 2½" Meter/RD/100Ma $3 @
DC 2½" Meter/RD/30VDC $3 @, 2/$5
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Converter Filter Input/3A @ 30VDC 4/$1
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- Kit 6 "SunCells" Battys
- Kit 10 Sub-Min Tubes
- Kit 12 Alligator Clips Asstd
- Kit (6) Tube Clamps Asstd
- Kit (32) Transistors PNP & NPN
- Kit (12) 2Amp Stud Rectifiers
- Kit 75 Mica Condensers
- Kit 10 Crystal Diodes
- Kit 200ft Hook Up Wire
- Kit 4 Rolls, 500ft/ea. Assorted Color
- Kit 5 FT243 Xtal Holders
- Kit 10 Xtal Osc. Blanks
- Kit 4 Asstd Rectifiers
- Kit 100 Self/Tap Screws
- Kit Adj Wire Striper & Cut
- Kit Hi Gain Xtal Mike
- Kit 2 pair SO239 & PL59
- Kit 12 Binding Posts Asstd
- Kit (3) TO36/50Watt Untested
- Kit (50) TOPHAT 3/4A/Diodes Untested
- Kit (12) TO3/3A Transistors Untested
- Kit (4) PF/PressFit 18Amp Studs

Order Ten (10) Kits—We Ship Eleven

One Each Above Kit Only. Each Kit 99c

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Cndsr Oil 6Mfd @ 1500V $4 @, 4/$10
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Pwr Sup Kit 1200VDC @ 200Ma/Xfmr & FWB Silicon Rect $10 @, 2 for $18
Modulation Xfmr 60W/15K to 5.7K $5
Headset Rubber Bunyon Pads pair $1
Socket Ceramic 1625 Tube 4/$1
Socket Ceramic 866 Tube 4/$1
Socket Ceramic 4X150/Loktal 4/$2

WANTED YOUR - ORDER - TODAY!

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Knob Spin-Crank BC348 Type $1
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8 foot Elec. Cord #16ga & Plug 39c @, 3/$1
Fuse 250Ma/3AG 5 for 30c, 100 for $3

DON'T C-WRITE & SEND ORDER!

XMTTG Mica Condsr .006 @ 2.5Kv 39c @, 5/$1
XMTTG Mica Cndsr .00025 @ 8Kv 75c @, 4/$2
Mini-Rectifier FWB 25Ma @ 115VDC 3 for $1
Micro-Switch Rated 40Amp AC & DC 4 for $1
BandPass Filters 60 or 90 or 150Cys 3 for $5
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"Bruning" 6" Parallel Rule #1 @ 3 for $2
Linear SawTooth Pot KS15183/W. E. 3 for $1

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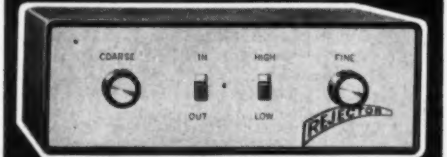
NOW! IMPROVE YOUR

RECEIVER—TRANSCEIVER RECEPTION



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ONLY $39.95

*Patent applied for

THE REJECTOR TUNABLE NOTCH FILTER WILL GREATLY IMPROVE RECEPTION ON ANY RECEIVER OR TRANSCEIVER—HAM/CB/SW.

■ No insertion loss. ■ Audio filter with tunable range 300 to 4000 cycles. ■ Fully transistorized. ■ Ideal for CW-RTTY-SSB-AM-SWL. ■ Simply connects between receiver or transceiver audio output and P.M. speaker. Apply 12V. ac/dc (1/2A) Size—7 1/2" x5 3/8"x 2 1/2". Opt'l AC Supply—$6.95.

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Dept. 73

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$15.95

New

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WRL

WVG MARK II

New low cost vertical antenna which can be tuned to any amateur band 10—80 meters by simple adjustment of feed point on matching base inductor. Efficient radiator on 10, 15, 20, 40, 75 and 80 meters. Designed to be fed with 52 ohm coaxial cable.

Conveniently used when installed on a short 1-5/8" mast driven into the ground. Simple additional grounding wire completes the installation. Roof top or tower installation. Single band operation ideal for installations of this type. Amazing efficiency for DX or local contacts. Installed in minutes and can be used as a portable antenna.

Mechanical Specifications: Overall height — 18' Assembled (5' Knocked down) Tubing diameter — 1¼" to 7/16". Maximum Wind Unguyed Survival — 50 MPH. Matching Inductor — Air Wound Coil 3½" dia. Mounting bracket designed for 1-5/8" mast. Steel parts irridite treated to Mils Specs. Base Insulator material — Fiberglas impregnated styrene.

Electrical Specifications: Multi-band operation — 10-80 meters. Manual tap on matching inductor. Feed with 52-75 ohm line (unbalanced). Maximum power — 1000 watts AM or CW-2KW PEP. Omni-directional. Vertically Polarized.

WRL WORLD RADIO LABORATORIES

3415 West Broadway
Council Bluffs, Iowa

Dept. 73

☐ Check enclosed. ☐ Ship one WVG MK. II @ $15.95 Postpaid.

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Call_______________
Address_______________
City_______________
State_______________

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WRL

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3415 WEST BROADWAY/COUNCIL BLUFFS, IOWA/51504

☐ Ship Special Package ZZM088 — $199.95
☐ Ship Duo-Bander 84 — $159.95
☐ Send Information on other Duo-Bander Packages
☐ Quote attached Trade
☐ Send Free 1966 Catalog
☐ Check or money order enclosed F.O.B. Council Bluffs, Iowa

Name ______________________ Call __________

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City ______________ State ________ Zip ________

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TUNE
METER SENSITIVITY
MIC
MIC GAIN
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OFF
BANDSWITCH
PUSH 40
PULL 80

INTRODUCTORY OFFER UNTIL MAY 10TH

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